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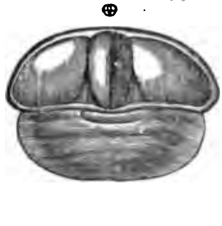

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CONTENTS OF VOLUME VII.

REVIEWS AND BOOK NOTICES.

BOTANY.

ZOOLOGY.

GEOLOGY.

ANTHROPOLOGY.

MICROSCOPY.

ERRATA.

Page 115, line 9, for Maynard *read* May. Page 177, line 16, for females (workers and queens) *read* drones, and in line 17, for drones *read* females (workers and queens). Page 228, lines 3 and 10 from bottom, for Bagshot *read* Bagehot. Page 530, Fig. 138 is not taken from Harris' work, but from Riley's Report on Injurious Insects of Missouri. Page 544, Fig. 147 is upside down. Page 567, line 1, for improved *read* unproved.

LIST OF PLATES.

LIST OF WOOD-CUTS.

Mr. [illegible] Palmer
[illegible]

THE AMERICAN NATURALIST.

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NOTES ON THE RIGHT AND SPERM WHALES.

BY PROF. N. S. SHALER.

THE following notes on the habits of the right whale were taken down in a conversation with Captain John Pease of Edgartown, an old whaler, whose powers of observation as well as of accurate and clear statement I have rarely known equalled. As far as possible these statements have been collated with those of other experienced whalers.

All of the south latitude right whales are without calves up to July 1st; the females are found in the bays about this time. The calves all come at once, it being but two or three days between the bearing of the first and last calves. None are found with the herd up to the 1st of July and every female has her calf by the 3d or 4th of the month.

The right and humpback whales are very fond of their young, taking no care of themselves in their efforts to save it; the sperm whales, on the other hand, are quite without affection as far as can be determined by their behavior.

Sperm whales have leaders of the herd which they follow with a certain obstinacy; these leaders seem to give the alarm to the others. No such subordination can be observed among right whales. Sperm whales, as is well known, have the males very much larger than the females, while the reverse is the case among the right whales. This is interesting in connection with the fact that the male sperm whales struggle furiously together, while the

males of the right whales seem to have no conflicts with each other. Captain Pease had seen males struggling with each other and often found their bodies scarred with the imprints of the rival's teeth; the scars showing their origin very distinctly by their form — the distance apart of the wounds answering to the intervals of the teeth. The great superiority in the size of the males among the sperm whales is just what would be expected in a species where the males struggled in the combats of rivals. The gain in size under the influence of these conflicts of the males is generally limited in land animals within pretty narrow bounds. There are probably no land animals where the male is double the weight of the female, yet the male sperm whale would seem to excel the female by more than this proportion. This extreme development of the males occurs also among the Otaridæ as well as among many groups of fishes, so it would seem as if there was some reason why the influences tending to limit size were less active in the sea than on the land. The reason for the greater freedom to acquire size in the sea is undoubtedly to be found in the less weight of bodies in that element, the effect of which is shown as well in the structures of man as in the structures of nature; the ship exceeds all vehicles for land transportation for the same reason and in something like the same proportion that marine animals, when size is the advantage, exceed terrestrial forms.

The conflicts between the males of sperm whales lead to great damage to the lower jaw; the evidence goes to show that at least two per cent. are crooked more or less, and one in several hundred very badly bent by these struggles. There are two specimens in the small museum at Nantucket which are singularly contorted; one of them is bent laterally into one turn of a spiral. Captain Pease tells me that he found one that was bent sideways at right angles to the proper position and firmly fixed there, seeming to be a permanency in this singular place. In fighting, the males rush at each other with open jaws and strike in passing. The great speed and power of these massive creatures must lead to the most serious results from these collisions. Capt. Pease found a sperm whale nearly dead on the water with the lower jaw hanging by a single band of ligament a few inches through. The creature was being devoured by sharks and crustaceans, but the wrench which had crippled this whale must have come from one of his kind.

Captain Pease has several times seen the killer attack right and humpback whales; they strike for the tongue if possible. They often jump many feet from the water and fall upon him. Many individuals, fifty or more, join in this attack. They tear out large pieces from the blubber, food being evidently the object of their attack. Their great activity makes the whale helpless against them, though he will struggle furiously before overborne. They sometimes drag down the whale after it has been killed by the whalemen.

The Captain was quite sure that the chief article of food of the sperm whale is squid, as they vomit large quantities of them in their death agonies; he thinks that the whales take them by swimming with the mouth so wide open that the lower jaw stands at nearly right angles to the upper. Squid, he thinks, will grasp at the jaw as the whale passes among them and are cut in fragments by the sudden closure of the jaws. He says that the jaw is closed with prodigious force and suddenness so that when out of water the noise can be heard for two or three miles, and is even noticeable under water. He stoutly maintains that he has seen fragments of squid, where the whales had cut them in two, exposing the cavity of the body, which was as large over as the head of a forty gallon cask. In one case he saw the head of a squid which he believes to have been as large as a sugar hogshead.

The Captain is convinced that the right whale has a trace of hair within the skin. He says that when the skin is fresh, if it be scraped with a knife so as to remove the superficial parts, there will then be seen a trace of hair in the inner section. This point is worthy of attention from those naturalists who have opportunities for such work. It is evident that if the whale is the descendant of some land mammal form it would be likely to preserve a trace of the hairy covering. In this connection it is interesting to note that, in the museum at Nantucket, there is a tooth of a sperm whale with two fangs after the fashion of an ordinary mammalian canine. The specimen was taken many years ago, but with it is the statement that the other teeth of the whale were of the same fashion. This clearly looks like a reversion to some higher mammalian form of dentition.

Captain Pease thinks that right whales attain very nearly their adult size in three years, there being about three distinct sizes found at one time in the sea. He thinks, however, that they may continue to grow very slowly for some years longer, the ultimate

size depending a good deal upon the haunt of the whale; some regions having larger specimens than others. If the whales are descendants of our marine carnivora we should expect them to preserve something like the same growth rates, for this feature seems to be tolerably permanent in any group of related animals. The rate of growth, deducible from the observations of the practical students of the whale, coincides pretty closely with what we should be inclined to expect on the supposition that the cetacea were descended from some ancestor like the marine carnivora.

The great decline of the whale fishery in all countries seems likely to deprive us of the ill-used opportunities, which naturalists have long had, of making themselves acquainted with the habits of the greatest of the mammals. There are many questions which should be discussed and settled before the class of clear headed and observant whalemen has passed away; else we may remain for centuries without a competent knowledge of the ways of this, the greatest living monument of animal life.

OUR POISONOUS PLANTS.

BY W. W. BAILEY.

THE poisonous plants of our northern woods are not so numerous but that they may easily be learned. Of them certain members of the sumac family (*Anacardiaceæ*) have the most evil reputation. To this order belong the so-called dogwood (*Rhus venenata*), and the poison-ivy (*Rhus toxicodendron*). The dogwood must not be confounded with the beautiful *Cornus florida*, which unfortunately bears the same familiar name. This tree is perfectly innocent and is so highly ornamental that it would be a shame if through simple ignorance it should ever be cut down.

There are two varieties of *Rhus toxicodendron*, distinguished by slight differences in the leaves. When these are cut-lobed, the plant is *R. toxicodendron* (Fig. 1); when entire, it bears the name of *R. radicans*. Some authors have considered them distinct species, but there is no doubt they are merely modifications of one. Both forms are occasionally mistaken for the Virginian creeper (*Ampelopsis quinquefolia*, Fig. 2) to which the climbing forms bear

little resemblance. They may, however, be always distinguished from that graceful plant by the three leaflets on a stem, and by the mossy aggregation of roots by which they adhere to trees and rocks. The Virginian creeper, on the contrary, has *five* leaflets and is furnished with tendrils which expand into sucker-like disks to assist the plant in climbing. It turns a vivid crimson in autumn, and as it is seen climbing some evergreen or trailing over a stone wall is one of the chief ornaments of that season. The poison-ivy also colors beautifully, but I think much sooner, and the tints are different, bright yellow, orange, or mahogany. Many persons have been induced, by their own ignorance or the superficial knowledge of their friends, to avoid or even destroy the harmless woodbine, or else have suffered by a too free handling of its mischievous neighbor. I say neighbor, as the two are often found near together and are similar in their habits of growth. The poison-ivy is very common, and may even be seen embracing the fences or wrapping large trees with its snaky branches. It is said sometimes to invest trees so closely as to cause their death. However that may be, I have seen its foliage entirely replace that of some lofty elm, now dead, and dependent alone for its beauty upon the plant the growth of which it had assisted.

A more dangerous plant, yet one of the most beautiful trees which we meet in swamps, is the poison-dogwood (*Rhus venenata* Fig. 3). It has from seven to thirteen leaflets on a common stalk, an odd one terminating the series. Its autumn coloring is magnificent, passing from green through a bright yellow, to crimson and scarlet, the midrib remaining in each case an intense red. Thoreau says, somewhere, that the plant appears to "blush for its sins." With its smooth gray bark and pinnate foliage it is conspicuous always, and when once known is easily remembered, but the desired information is often the result of a sad experience. Painful swellings, inflammation, and intense itchings are to many the result of contact with it, or even with the less noxious *Rhus toxicodendron*. Some persons are even affected by passing near, while others may handle it with absolute impunity. It is said, however, that even the chosen few are not always exempt from its influence, a profuse perspiration or some unusual condition of the system rendering those susceptible who usually have no cause to fear. I have myself often squeezed the leaves in my hands, and never avoid the tree when it lies in my way,

Fig. 1.

Poison Ivy (Rhus toxicodendron).

Fig. 2.

Virginia Creeper (Ampelopsis quinquefolia).

and I have as yet experienced no consequent suffering. The poisonous property of these plants appears to reside in the resinous juice, and may be removed by boiling and evaporation. Upon exposure to the air the juice blackens and forms an indelible ink.

The *Ranunculaceæ*, or crowfoot family, form a very suspicious order of plants; those which are not absolutely poisonous having generally an acrid or bitter juice. *Ranunculus acris* is especially caustic, and when fresh is avoided by cattle. Drying appears to

Fig. 3.

Poison Dogwood (Rhus venenata).

remove the poison. This is the tallest of our buttercups, with leaves "three divided; *the divisions all sessile* and three cleft or parted, their segments cut into lanceolate or linear crowded lobes." When taken internally some of the buttercups will produce dangerous symptoms, but this is an accident not very liable to happen, as their blistering tendency would cause them to be rejected without swallowing.

Fatal mistakes have occurred when persons have eaten the root of the monkshood (*Aconitum Napellus*) in early spring ere the

leaves served to distinguish it, thinking it to be horseradish. It is an introduced plant and will only be met with in cultivation, or in old gardens or waste places, and it is so generally known to all, that I will not delay to describe it. I will mention, however, a peculiar tingling sensation which it produces when applied to the tongue, an effect of some duration. The anemones, the larkspurs (*Delphinium*), and the bane-berries (*Actæa*) all contain in greater or less degree an active principle which becomes dissipated upon drying as in the case of the buttercups. Even the pretty roots of the common gold-thread (*Coptis trifolia*) are intensely bitter, and are sometimes used as a cure for children afflicted with diseases of the mouth. As a rule it is well to be cautious in our treatment of any plant the characters of which indicate that it belongs to the *Ranunculaceæ*.

The parsley family (*Umbelliferæ*) may be recognized by the small, generally white or yellow flowers, disposed in spreading umbels, with mostly compound leaves, often very delicately dissected, as in the common carrot (*Daucus carota*). The flowers and leaves of this plant, or of the parsnip or parsley, will serve as types of the whole order, to which belong many of our most noxious plants as well as wholesome vegetables. The species, owing to their similarity and the minuteness of the inflorescence, are difficult to distinguish and in consequence it can not be certainly affirmed how many are injurious. They are determined mostly from the seeds and flowers.

This, like the last, is a suspicious order, the more so, perhaps, from the fact of its containing certain edible members, for which their noxious relatives may be mistaken. Accidents are therefore of quite frequent occurrence, especially among children. Our native water-hemlock (*Cicuta maculata*, Fig. 4) is very poisonous. It is said that "a drachm of the fresh root has killed a boy in an hour and a half!"* The plant is far too common for safety, and is found in swamps and wet places, even within the limits of our cities. It is a tall, rank herb, the smooth stems streaked with purple, the flowers white, and the veins of the compound leaves terminating in the notches. Still more to be avoided is the introduced hemlock (*Conium maculatum*) which has a very similar habit and appearance. It has smooth, spotted stems, and an offensive mousy smell, which treatment with potash brings out more strongly. It is supposed to be the poison by which the ancients eliminated

their troublesome politicians, and if this were not a serious article I might perhaps grow facetious, and suggest its use at the present time. It is now employed to some extent in medicine. Its name "hemlock" is an unfortunate one, as it is shared with that most elegant spruce, the *Abies Canadensis*, and I have known nervous people to avoid the latter for the sins of its fearful namesake. It

Fig. 4.

Water Hemlock (Cicuta maculata).

is said that the well known celery which belongs to this family and grows wild in England is, in its native state, dangerous for food, and is only made palatable and innocuous by the process of bleaching to which it is subjected. The active principle can only be developed with free access of light.

The nightshade, like the parsley family, contains both edible and poisonous plants. The potato (*Solanum tuberosum*), the egg-plant

(*Solanum melongena*), the tomato (*Lycopersicum esculentum*), the strawberry tomato (*Physalis*), are well known esculent vegetables; but even with these, certain portions of the plant are often poisonous or narcotic, as in the case of the potato, where the berries and leaves are injurious. I once saw a boy in New Brunswick eating the large green potato berries, but to my mild remonstrance he replied that he had often done so before without any resulting trouble. It would therefore appear that if actually dangerous, the fruit may not be so to all constitutions.

It is doubtful whether the bright red berries of the bitter-sweet (*Solanum dulcamara*) are in any degree injurious, but so long as their innocence is not established, it is just as well to treat them with caution. The common nightshade (*Solanum nigrum*), often found about houses, is more certainly dangerous. Young children, unless prevented, are almost sure to eat the berries of the bitter-sweet, attracted by their brilliant and luscious appearance. The bright blue, showy flowers bear a striking resemblance to those of potato. The thorn-apple (*Datura stramonium*) always found growing in waste places may be known by its morning-glory-like flowers, white, shaded with violet, its large, spiny seed pods, and its most offensive odor. As with the potato, the bitter-sweet, and other members of the genus *Solanum*, the leaves are always found perforated by insects. The seeds are said to have been used by the Delphic priests to excite their mad ravings, which the Greeks understood as prophecies.

In the order Liliaceæ, we have the American white hellebore (*Veratrum viride*), the root of which is a deadly poison. The plant is known familiarly as Indian poke, and has coarse fibrous roots, and elegantly plaited leaves, which in early spring may be seen by the banks of streams, generally in company with the skunk-cabbage, from which, however, it is easily distinguishable. The latter throws up its curiously painted, shell-like spathe in early April or even in March, the flower preceding the leaves, while the hellebore blooms in the summer, and has a tall upright spike of greenish flowers, in no respect resembling those of its neighbor. The active principle contained, is the alkaloid veratria, used to some extent in medicine.

The jack-in-the-pulpit (*Arisœma triphyllum*) is found in similar localities and, although not strictly a poison, its root is very acrid and caustic, as the children with the average propensity for inves-

tigation have discovered to their cost. The disgusting odor of the skunk-cabbage (*Symplocarpus fœtidus*) must always preclude similar experiments. Both of these plants belong to the order Araceæ, of which the sweet flag (*Acorus calamus*) is also a member.

Certain of the fig-worts (*Scrophulariaceæ*) are narcotic poisons, but I know of none which need any special mention. The dogbanes (*Apocynaceæ*) belong to a poisonous family of which it is well to be careful, although, so far as I am aware, our two pretty species need not be avoided. They have a milky acrid juice, as do the Euphorbias to which the same remarks apply. In the (*Urticaceæ*) we have the hemp (*Cannabis sativa*) which, in the east, yields the well known drug called hasheesh. In our climate, I believe this poison is not developed. The nettles belong to the same family but it is unnecessary to point out the eminent propriety of handling these with gloves, as some of them are provided with stinging hairs. According to Scott, they are when young used as greens in Scotland and cultivated for that purpose. (Rob Roy, Chap. 8).

The Indian tobacco so much used by quacks, is *Lobelia inflata*, a common little plant in open fields, with light blue flowers and inflated pods. The blossoms are very much smaller than those of the cardinal flower (*Lobelia cardinalis*), but of the same general appearance. All the lobelias are poisonous, and are much too recklessly employed by those who have little knowledge of their power. It is said by Darlington that the quacks give the name of *high*-belia to the cardinal flower to distinguish it from *low*-belia. This gives some idea of the amount of their learning.

There are some others of our native plants which possess an acrid juice, but I think I have now mentioned all that should be known with the exception of certain fungi with which I am not familiar. Among the grasses, there is but one, the darnel (*Lolium temulentum*), that has the reputation of being noxious, and late investigations appear to throw much doubt upon previous statements in regard to it. The *Kalmia latifolia* in Ericaceæ has been said to poison cattle, but the assertion has not been proved.

In reviewing the plants now mentioned, we find three that are poisons to the touch, *Rhus venenata*, *Rhus toxicodendron* and the nettles (*Urticæ*). The following are narcotic irritants, *Veratrum*, *Aconitum*, *Cicuta*, *Conium*, *Datura*, *Atropa*, *Lobelia*. The butter-

cups are acrid and caustic, as are the *Araceæ*, while Coptis is simply bitter.

I have been able to offer but a sketch of our poisonous plants, and may have omitted to mention a few. I have been surprised in studying them to find how little appears to have been written about them except as regards their medicinal effects, and how this little is distributed in many different books. I cannot close this article without a renewed warning against the reckless use of herbs whose effects may be deleterious or even fatal.

A GLIMPSE AT COLORADO AND ITS BIRDS.

BY C. E. AIKEN.

Early this morning, the 17th of October, as I was riding past Beaver Creek, a large and beautiful mountain stream that flows through portions of El Paso, Fremont and Puebla Counties, my attention was attracted by a great twittering among the feathered tribe in an enclosure on the creek bottom. As there seemed to be an unusually large congregation of species for this season of the year, I dismounted from my pony, and leaning upon the cottonwood rail-fence, I watched the birds for nearly an hour, noting the different varieties, and observing the actions of each.

Immediately in front of me was a low, dense, wild-plum thicket, overrun and interwoven with hop-vines, but at this season nearly stripped of its leaves; and it seemed this morning as though each fallen leaf had been replaced with a little feathered songster. At least a dozen species were represented; but the white-crowned sparrows were by far the most numerous, and the singing or twittering of these it was, that first drew my attention.

Beyond this thicket, a thrifty growth of cottonwood extended along the banks of the creek from right to left, from the midst of which the songs of numerous robins, and of one or two other birds, rang out as clear and joyous as in early springtime. Many of the trees had their trunks encased in wild grape or hop-vines, and most of them were bare of leaves; but occasionally a tree clothed in a bright yellow foliage relieved the monotony and beautified the view. A high, rocky, barren ridge that formed the west

wall of the creek cañon extended across the background. At my right hand was a small stubble-field in the midst of the tangled brush, and a little to the left a clump of scrubby oaks. Several small trees scattered through the foreground, with here and there a clump of differently tinted red, green or yellow bushes, completed the landscape. Imagine now the whole enlivened with birds and you have the entire picture.

On account of their bright plumage and boisterous actions, Woodhouse's jay and the magpie were most prominent; particularly the former, of which there were about a dozen individuals that kept flying in and out among the bushes before me. Occasionally one would fly up on to the limb of a tree, where it would pause but a moment to swallow the morsel of food it had brought, or to look about it, and then off it went with a wild, chattering note. The low oak bushes that are so abundant in the foothills are the chosen haunts of these birds, and they are never found at any great distance from them. A magpie in the cottonwood grove, espying me, came over directly to satisfy his curiosity, which, by the way, is a prominent feature in his character. He alighted on the top of a fence-stake within ten feet of me, and giving his beautiful, long, glossy tail a jerk, and ducking his head impertinently, he uttered a harsh, bold note of inquiry; but when I turned my head to obtain a better view of him, he was off in an instant.

Another noticeable bird was the arctic finch (*Pipilo arcticus*). These were to be seen everywhere, among the bushes, on the ground, or flying from one thicket to another and, from their abundance, form one of the characteristic birds of this section. At this season they are very quiet, and usually keep themselves concealed in the brush; but during the early part of the season, the males were seen on every hand, perched in the top of some bush, and singing the same song that we are accustomed to hear from our "chewink" at the East. Nearly all of them have already left for warmer regions, and a few days more will probably see the last of them here, until they return next April. I noticed one of these little fellows busily scratching on the ground beneath some bushes close by, and nearly buried among the dead leaves he had heaped up around himself. Becoming shortly aware of my presence, he straightened up, raised the feathers of his crown into a crest, and twitching his little head first one way and then another, he sur-

veyed me from head to foot; then, as though satisfied that all was not right, he hopped cautiously to the next clump of bushes, and then flying close along the ground, disappeared in the thicket.

A dove, that alighted near me, stretched up its neck, looked timidly at me an instant, and then flew away, and a Townsend's flycatcher that came down from the cedar-clad ridge behind me to quench its thirst, lingered about for a few moments and then, becoming frightened at some invisible thing, hastened back to its secluded retreat. A red-shafted flicker rapped industriously for awhile, on an old dead cottonwood, and then left for more productive fields. Hearing the low whistle of the cedar bird above me, I looked up and saw several of them flying over. These were the first I had seen for nearly a year. In response to my call a flock of Arkansas finches (*Chrysomitris psaltria*), that were flying past, settled among the topmost twigs of the thicket, and silently eyed several purple and house finches that occupied similar positions about them. These little beauties are the last to greet us in summer, and among the last to leave in autumn, which is quite unusual in our summer visitors; those coming last being generally the first to leave and *vice versa.* They did not become common here this season until the first of July, yet I noticed them last fall as late as the fifth of November. The males still wear their summer plumage, and appear at a short distance as bright as when they first arrived from the South.

From the cottonwood grove, I recognized the familiar notes of the song sparrow, and soon one of these appeared in the edge of the thicket near me, with a Lincoln's finch for a neighbor. A flock of tree sparrows just from the North, and a solitary chipping sparrow that had lingered a few days behind the rest of his tribe, were also among the occupants of the thicket. The Oregon snowbird too, and the more recently described *Junco annectens*, were each represented there by a single individual; and once I thought I saw a chat among its branches, but as I have not observed any of these birds for a month, I was probably mistaken. Then a flock of six or eight bluebirds (Sialia arctica), probably an old pair with their young, passed on their way southward, and three or four Brewer's blackbirds that seemed to have no destination in particular made a short halt near by. Then a flock of thirty or forty noisy, cawing, Maximillian's jays settled down on the stubble-field where they remained until one of their number, seeing me, gave a caw, when

with a great racket they all rose together like a flock of blackbirds and returned to their haunts among the cedars far up the cañon. For some time a pair of mallard ducks had been circling about as though looking for a place to alight, and finally they selected a bend in the creek just in front of me. Above the ridge beyond the creek, a turkey buzzard was floating listlessly in the morning sun, apparently without the least exertion on his part. I watched him carefully for several moments as he circled about, but could not detect the slightest motion in his wings.

One other bird I saw here to which is attached a good deal of interest, the white-necked crow (*Corvus cryptoleucus*). I have found these birds common along the base of the Rocky Mountains, from Cheyenne at the north, to Trinidad at the south; and from the Snowy Range, to a point thirty miles out on the plain, yet Mr. Ridgway writes me that these birds "are entirely out of their previously known range." I strongly suspect that this bird has been mistaken by naturalists, who have ornithologized in this section, for the common American raven (*Corvus carnivorus*), since it seems to me impossible that any one should remain here any length of time without seeing it; still the Western bluebird (*Sialia Mexicana*), and several other birds which are equally abundant here, are in the same predicament. The raven is said to be common in Colorado, but during a year spent in collecting in different parts of the territory, I have seen but a single pair!

HARVEST MITES.

BY PROF. C. V. RILEY.

In the "American Entomologist" (vol. 1, no. 5) an account was given of the eight true insects, and of some other ringed animals or articulates, known to be parasitic on man. The insects are, the head-louse (*Pediculus humanus* Linn.), the body-louse (*Pediculus cervicalis* Linn.), the crab-louse (*Pediculus pubis* Linn.), the human bot-fly (*Œstrus hominis* Gmelin), the common flea (*Pulex irritans* Linn.), the chigoe (*Pulex penetrans* Linn.), the common bed-bug (*Acanthia lectularia* Linn.) and the big bed-bug (*Conorhinus sanguisuga* Le C.).

The only mite that is known to attack man, and whose appearance is at all familiar, is the itch mite (*Acarus scabiei* Linn.). We have, however, in the southwestern States, two other mites which cause great annoyance from harvest time till into October, to people who frequent the rank herbage and grass in our forest openings or along our rivers. Both of them are six-legged, reddish, microscopic specks, and both are popularly termed jiggers; but as this term is universally applied to the more dangerous *Pulex penetrans* (a true flea occurring in Central America but not in the United States), and as a European mite (*Leptus autumnalis*), having similar habits to ours, is there popularly called "harvest bug," we may apply to our species the term "harvest mites."

Before we can talk intelligently and definitely of anything that moves or has a being upon our earth, it must receive some scientific appellation. According to my friend, A. S. Packard, Jr., and from our present knowledge of the transformation of mites, we may very plausibly conclude that these six-legged forms are but the young of some eight-legged form such as Trombidium, to which belongs our common "red spider." Now it is contrary to all scientific usage to name and describe a species from its immature characters; but the older authors not only described these six-legged mites as perfect animals, but referred the different forms to different genera. Therefore, as it is important that such common and annoying pests should have a "local habitation and a name," and as they are so far only known in the six-legged state, I shall provisionally, and for the sake of convenience, name them. Should any future arachnologist learn the true life history of either, he may, of course, recognize or reject these names as he sees fit.

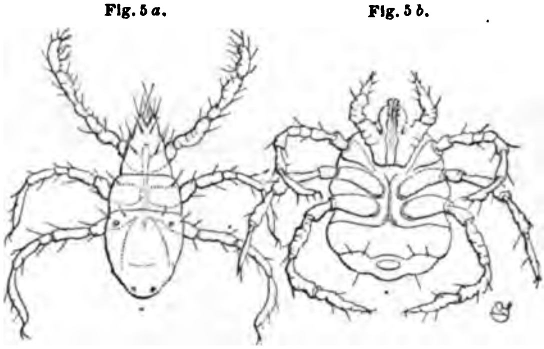
*The American Harvest mite** (*Leptus Americanus? n. sp.* Fig. 5 *a*). — This species is barely visible with the naked eye, moves readily and is found more frequently upon children than upon adults. It lives mostly on the scalp and under the arm-pits, but is sometimes found on the other parts of the body. It does not bury itself in the flesh, but simply insinuates the anterior part of its body just under the skin, thereby causing intense irritation, followed by a little red pimple. As with our common ticks, the

*Color brick-red, slender, ovate, the narrow, anterior end bifid, and furnished with stiff, converging setæ. Six-legged; legs long, the front pair blunt and slightly thickened at tip where they are incurved and thickly armed with stiff hairs; the others rather longer, and terminating in a stiff, curved, furcate claw. Average length ·008 inch.

irritation lasts only while the animal is securing itself, and its presence would afterwards scarcely be noticed but for the pimple which results.

*The Irritating Harvest mite** (*Leptus irritans*, *n. sp.* Fig. 5 *b*). This is the more troublesome and, perhaps, better known of the two, causing intense irritation and swelling on all parts of the body, but more especially on the legs and around the ankles. Woe betide the person who, after bathing in the Mississippi anywhere in this latitude, is lured to some green dressing-spot of weeds or grass! He may, for the time, consider himself fortunate in getting rid of mud and dirt, but he will afterwards find to his sorrow that he got hold of something far more tenacious, in these microscopic harvest mites. If he has obtained a good supply of

Fig. 5 *a*. Fig. 5 *b*.



Harvest Mites.

them, he will, in a few hours, begin to suffer from severe itching, and for the next two or three days he will be likely to scratch until his limbs are sore.

With the strong mandibles, and the elbowed maxillæ, which act like arms, this mite is able to bury itself completely in the flesh, thereby causing a red swelling with a pale pustulous centre containing watery matter. If, in scratching, the person affected is fortunate enough to remove the mite before it enters, the part soon heals. But otherwise the irritation lasts for two, three or four days, the pustulous centre reappearing as often as it is broken.

* Color brick, or blood-red; of tick-like form, being nearly as broad in front as behind; six-legged, the legs terminating in two stiff hairs; a strong pair of elbowed maxillæ, recalling a fourth pair of legs, and similarly terminating in two hairs; mandibles more or less distinctly tridentate at end inside. Length .01 inch.

The animal itself, on account of its minute size, is seldom seen; and the uninitiated, when first troubled with it, are often alarmed at the symptoms and at a loss to account for them. Fortunately, these little plagues never attach to persons in such immense numbers as do sometimes young or so-called "seed" ticks; but I have known cases where, with irritation and consequent scratching, the flesh had the appearance of being covered with ulcers; and in some localities, where these pests most abound, sulphur is often sprinkled, during "jigger" season, in foot-gear as a protection.

Sulphur-ointment is the best remedy against the effects of either of these mites, though when that cannot be obtained, saleratus water, and salt water will partially allay the irritation.

The normal food of either must, apparently, consist of the juices of plants, and the love of blood proves ruinous to those individuals who get a chance to indulge it. For unlike the true chigoe the female of which deposits eggs in the wound she makes, these harvest bugs have no object of the kind, and, when not killed at the hands of those they torment, they soon die — victims to their sanguinary appetite.

ON THE GENETIC RELATIONS OF THE CETACEANS AND THE METHODS INVOLVED IN DISCOVERY.

BY THEODORE GILL, M.D., PH.D.

In a "Synopsis of the Primary Subdivisions of the Cetaceans," published in 1871,* I ventured some remarks on the apparent genetic relations of the Cetaceans, and observed that "between the Carnivores and the Cetaceans of the present age, the gap does indeed appear to be very great, but it is bridged over, to a very considerable extent, by the Zeuglodonts of the Tertiary epoch, ... and from the Zeuglodont stem have probably descended, in different directions, the toothed and whalebone whales; while the former, in some features, such as the general form of the skull, the teeth, etc., appear to deviate less from ordinary mammals; the latter, in other respects, but especially in the development of

* Proceedings and Communications Essex Inst., vol. vi, pp. 121-126.

the olfactory organ and of the nasal bones, depart less than they from the typical forms. It would therefore seem probable that the *Denticete* (Toothed whales) have become differentiated, as now recognized, little or not at all in advance of the *Mysticete* (Whalebone whales), or in other words that the latter are not offshoots from the former, but both from one original stock."

Dr. Brandt of St. Petersburg, to whom we are indebted for so many valuable memoirs in various departments of zoology, in a recent memoir on the classification of the Balænoidea* (or Mysticete), has misunderstood the tenor of these remarks, and supposing that I meant that the Balænoids (or Mysticete) and Delphinoids (or Denticete) were differentiated and developed from the Zeuglodonts in the Tertiary epoch, has expressed his dissent therefrom.

Such an interpretation illustrates the difficulty of expression so that there shall be no ambiguity. In view of my real sentiments, the interpretation in question struck me with astonishment on the first perusal, and at the same time appealed to my sense of the ludicrous. In season and perhaps out of season, in arguments with friends, and in public discourses, I have insisted upon the inadequacy of the palæontological record, and the absolute necessity, in view of our knowledge of the radical differences between the various types of animals, of extending the phylum of the various existing stocks into a most remote but necessarily indefinite past. I have even incurred the censure of geologists for insisting that the mammals, for example, must have been developed in a far earlier epoch than we have palæontological evidence of, and that even the palæozoic might not be too recent for their birth. The absurdity of the idea, that the specialized Denticetes and Mysticetes of the Tertiary epoch could have originated in that epoch and from tertiary Zeuglodonts, is such that it never occurred to me that it could be entertained by any scientific evolutionist, much less attributed to me. The remark that the gap between the Feræ and Cete is bridged over by the Zeuglodonts of the Tertiary epoch, and that from the Zeuglodont stem have descended the recent whales, certainly does not legitimately convey that idea, although, after consideration of the passage, I must confess that one unacquainted with any of my other writings might not be entirely in-

* BRANDT (Johann Friedrich). Ueber eine neue Classification der Bartenwale (Balaenoidea) mit Berücksichtigung der untergegangenen Gattungen derselben. . . . <Bulletin de l'Académie Impériale des Sciences de St.-Pétersbourg. t. 17, pp. 113–124, 1872; *also* < Mélanges Biologiques tirés du Bulletin. . . . . t. 8, pp. 317–338.

excusable for wresting such an interpretation therefrom, especially if my reference to their systematic places of the extinct typical Cetaceans was overlooked.

Methods involved in discovery. — In dealing with genetic problems, there are facts and inferences from facts to be considered.

As facts, the Zeuglodonts are less aberrant in structure and more related to the ordinary quadrupeds than are the existing Cetaceans, and they are not living, and their remains have only been found (or at least identified) in the Tertiary epoch.

As other facts, the Cetaceans of the present epoch share with the Zeuglodonts the special features which differentiate them as Cetaceans from other mammals, and superadd other specialized characteristics.

As facts, then, the Zeuglodonts (only yet known from tertiary beds) bridge over the gap between the Carnivores (or normal quadrupeds) and the existing Cetaceans, that is, they are more like the former than are the latter.

As inferences from these facts, it seems most probable that the known Zeuglodonts represent a stock relatively near the original stem or line of descent, and comparatively little differentiated (in at least the jaws, teeth, olfactory apparatus, members, etc.) from the generalized cetacean progenitors of the Denticetes and Mysticetes. Whether the restricted characters which might be applied to all the known Zeuglodonts could be extended to those atavan forms is questionable, but that the latter had the jaws, nasal apertures and teeth attributed to the suborder in my article is, I think, a perfectly legitimate inference from the facts and, therefore, it may with confidence be said that the Denticetes and the Mysticetes have originated from the generalized Zeuglodont stem (not Zeuglodonts) thus understood.

But when they originated is entirely another question, and for the solution of which we have no data. They — or one, or the other of them — may have become differentiated in the Cretaceous, or the Jurassic, or a still earlier age. I should probably in the main agree with Dr. Brandt, however remote he might place the date of origin* and at least would have no direct evidence to

* Especially as Dr. Brandt concedes that the Sirenians may have originated little before the Miocene (perhaps before the Eocene), with the Halitheriids as witnesses of the high degree of specialization as Sirenians which the Miocene forms had already attained. Generum Sireniorum, ab initio verisimiliter e formis inferioribus, species vel genera quædam Sireniorum, non alia animalia heterogenea (*Pachydermata*), sensim

sustain an opinion one way or the other. It seems very safe, however, in view of the relations of the extinct faunas of that epoch to those of our own, to assume that it could not have been as late as the Cretaceous epoch.

On so-called intermediate forms. — Dr. Brandt, in connection with the subject in question, has taught us how the genealogical record should and should not be sought. "The hypothesis of the derivation from earlier, older forms," says he, "can only be proved with certainty directly from palæontology, and in no wise from so-called intermediate forms, which may have also originated independently, neither can it be, by means of analogy, indirectly deduced from isolated facts in the history of development."*

Here again, I am happy to find that on the whole I have not been entertaining very different views from the eminent master; and I accept the dictum (which I have often urged myself) that the genealogical line can only be proved (in its details) by reference to the actual forms, and that many so-called "intermediate forms" are themselves derivatives from the same common progenitors (at different removes) as the more specialized types.

But if it is really meant that the so-called intermediate forms do in no wise indicate the line and mode of descent of the more specialized types, I must for the first time differ, and differ decidedly, from my eminent critic. Do the Prosimians afford *no* hint as to how the Simians have originated? *None*, the Hipparions, the Anchitheriids, and the Palæotheriids for the Horses? *None*, the Oreodonts and the Anoplotheres, for the Ruminants? *None*, the Marsupials and Monotremes for the mammals? *None*, the Dinosaurians for the Birds? *None*, the Dipnoans for the Batrachians? *None*, the Marsipobranchiates and the Leptocardians for the Fishes? But why enumerate more of the hosts that crowd upon the memory for almost equal recognition? If such intermediate forms really give no clews or hints as to how more specialized and aberrant forms may have originated and developed, then indeed are facts in biology almost as barren and inconsequential

sensimque procreandi potentiam possidentibus, exorturum, origines itaque ante periodum miocænam (imo forsan adeo eocænam) transponendæ esse videntur. — Brandt, Symb. Siren., 1868, p. 371.

* Die Annahme der Abstammung von frühern, ältern Formen kann nur direct auf paläontologischem Wege mit Bestimmtheit nachgewiesen, keineswegs aus sogenannten Mittelformen, die auch selbstständige sein können, oder aus vereinzelten, der Entwickelungsgeschichte entlehnten Thatsachen auf dem Wege der Analogie indirekt abgeleitet werden. — Brandt, *op. cit.*, 332.

for the evolutionist as for the believer in patterns and special creations.

But I cannot believe that Dr. Brandt really means what he says: my familiarity with his previous works and train of thought forbids such a belief and I cannot doubt till I shall be authoritatively undeceived, that his words simply involve a too energetic expression of dissent from those (if there be such) who would believe that all so-called intermediate forms are exactly those in the line of descent from the more primitive to the more specialized ones. If this only is meant, I still find myself in agreement with Dr. Brandt, and admit that so-called intermediate forms do not necessarily prove the line of descent, but (if rightly so called) they do furnish all ranges of indication from a vague hint to absolute proof, according as they be more or less generalized, and more or less allied to those extinct forms in the regular line of descent, and by which can alone be demonstrated with certainty, according to Dr. Brandt, the lineage of any form. But how will Dr. Brandt avail himself of palæontology and identify and recognize, when found, those ancestral types? How approach it otherwise than by the same methods by which the "generalized" and "intermediate" characters are recognized? The great difficulty, indeed, consists in the identification of the forms in the direct line of descent; and the exact identification is practically impossible, but it may be sooner or later sufficiently approximated to give us tolerably satisfactory ideas as to the origin and successive differentiation of various types. And that end will be attained by the recognition of forms as successively intermediate as to structure and time of development, and thus it will be exactly by intermediate forms (and not the less so because revealed by palæontology) that the lineage will be proved!

Toxonomic values of characters.—Dr. Brandt further contends that the teeth, the olfactory organs, and the nasal bones have no determinative value.* And yet he gives the suppression of the teeth and the coördinate development of whalebone as the sole distinctive characters of the whalebone whales. Therefore, it is evident that he thinks that the teeth do furnish distinctive characters. He recalls the familiar facts that in early youth all Ceta-

*"Auf die Zähne kann kein entscheidendes Gewicht gelegt werden .. Dem Geruchsorgan, oder den Nasenbeinen vermag ich gleichfalls keinen Werth bei der Verleitung der Abstammung beizulegen."—BRANDT, *op. cit.*, 332.

ceans have teeth, while on the other hand, not only the whalebone whales, but also many Delphinoids, in old age, are wholly toothless, while others have only one or two teeth. And still he uses the want of teeth in the whalebone whales as a distinctive character. And thus I find myself still on the same platform with Dr. Brandt as to practice although he appears to differ theoretically.

The coördination of the want of teeth with other characters in the whalebone whales is invariable for the known forms, and may therefore be used as a diagnostic character. The want or presence of teeth *per se* is a character of little importance and of extremely varying significance. In the Rhytinids, for example, the want of teeth is only of family value; in the walruses, the hypertrophy of the canines and concomitant atrophy or suppression of the incisors are also only of family value; in the Artiodactyle Ungulates the want of (upper) incisors indicates less than subordinal distinction for one group (Ruminants) and in another case (Phacochœrids) scarcely specific distinction! But when the teeth *are* developed, their structure and relations do afford hints, and most suggestive ones, and the significance of similarity is more than in ratio to the continuing agreement of teeth of increasingly complicated structure.

As to the jaws and the teeth, as well as other parts, they are, it seems to me, as matter of fact, more similar in the Zeuglodonts to those of ordinary mammals than are those of the Denticetes or the Mysticetes, and they are at the same time coördinated with other characters less aberrant; in other words, they are in all essential respects more similar to the ordinary mammals than are the existing Cetaceans and, therefore, to use the favorite expression of Dr. Brandt, *ubi plurima nitent*, they are, inferentially, more nearly allied to and less divergent from the ancestral stem. If, however, it is denied* that they are more similar, I will only reply that I prefer to rely upon the evidence of my senses, and

* Nicht blos die Schädel der *Bartenwale*, sondern auch die der *Delphiniden* erscheinen nach meiner Ansicht im Vergleich mit den Schädeln der Landsäugethiere auf eigenthümliche Weise ziemlich *gleich anomal* und bilden zwei für den Aufenthalt im hohen Meere geeignete und dazu durch Naturgesetz bestimmte, selbstständige Schädeltypen, denen sich als dritter *gleichwerthiger*, zu den *Phocaceen* hinneigender Schädeltypus, der der *Zeuglodonten* anschliesst.—BRANDT, *op. cit.*, 331.

This passage is *apropos* of my remarks respecting the intermediate character of the Zeuglodonts quoted in the introduction to this article. The only comment I shall venture shall be in the form of a question. If the Zeuglodonts incline towards the Phocacea in their skull, why are they not to that extent (less their own deviation from the direct lineage) intermediate between the recent whales and the Phocacea?

even if the facts do not appeal to the senses of another in like manner, still do I prefer to trust to my own.

Inferences respecting genetic relations.—The question having been raised as to the comparative degrees of differentiation of the cetaceous types, it may be well to pursue it further.

Zeuglodonts. As already observed, the Zeuglodonts, in the form and structure of the jaws, the character of the teeth (molars double-rooted in part), the presence of the typical (Educabilian) number of teeth in the intermaxillary bones, the more or less anterior position of the nostrils, the contour of the skull and general relations of its constituent elements, and in fact almost all the known parts of their organization, differ much less from the ordinary mammals than do any of the existing Cetaceans. They are therefore the most generalized or the least specialized Cetaceans known ; these are simple facts which appeal to the senses. As inferences, the forms so distinguished represent, better than any other Cetaceans, the primitive ones from which they, as well as the latter, have descended. None of the known Zeuglodonts can, indeed, be the progenitors of the modern Cetaceans, since types closely related to the latter are associated with them in tertiary strata, and the known Zeuglodonts may have become much differentiated (possibly even more than the modern Cetaceans), in some minor points, from the primitive forms, but that they are, as a whole and in all essential features, more like (and therefore more allied to) those ancestral types can scarcely be doubted, *me judice*. Therefore those Zeuglodonts may appropriately be regarded as the nearest known representatives of the Protocetacean types, as quasi-intermediate forms between the quadruped mammals and the more specialized Cetaceans, and in a genealogical system must be represented as the nearest of kin to the prototypes of the order.

But even the few forms of Zeuglodonts known differ in degrees of differentiation from the normal mammals, and must be so represented, the *Basilosauriids* representing a more generalized and the *Cynorcids* a more specialized type.

Mysticetes. It seems more probable that the agreement of the Mysticetes and Denticetes in the attenuated intermaxillaries, the anterior nostrils, pectoral members, etc., should be the result of inheritance than of independent assumption, and therefore that they have developed from forms thus differentiated from the primitive Zeuglodont stem.

As to the forms most generalized, serious doubts may be entertained. The Denticetes have almost universally been considered as entitled to that rank, and if the form of the jaws and the teeth are alone considered, such would seem to be undoubtedly the correct view. But in other respects (such *e. g.* as the relations of the bones around the calvarium, the frontals, the posterior portion of the maxillaries, the development of the lachrymal, the less atrophy of the pelvis, the rudimentary hind limbs) the Mysticetes appear to me to be the most generalized, and, although the evidence may be vague and inconclusive, I may be permitted, till contrary evidence supervenes, to represent such apparent probability in a genealogical system. Of the two families (*Balœnopteridœ* and *Balœnidœ*) known, the Balænids appear to have superadded to the Mysticete type the most specialized feature and most generalized characters, such, for example, as the orbital prolongations of the frontal bones, the reduced coronoid processes of the lower jaw, etc.

Denticetes. Respecting the families of Denticetes the evidence is also vague, but hints are furnished by various structural characters. These may be illusive, but in default of evidence to the contrary, and until superseded, may be followed. It may be that other parts would furnish conflicting testimony, that there may be an unusual persistence of primitive characters in some regions, while in some others the structure has been much modified, and it is even not impossible that there may have been a reversion to ancestral characteristics in certain parts, but until such deviations are proved, it seems most in accord with sound philosophy to take provisionally, and in default of other, the *prima facie* evidence offered. With these remarks, the succession of the various families of Denticetes may be sought.

In the first place, two forms present themselves, each of which presents claims for the nearest representation of the ancestral line —the Iniids and the Ziphiids. The Iniids, and their near relatives the Platanistids, offer in their comparatively long neck and free vertebræ testimony in favor of such title, while the Ziphiids, in the development and continued independence of the lachrymal bones, produce theirs. And it seems very much more credible that these characters should have been inherited without fault than that they should have been the result of reversion after once having been lost, especially as there appear to be no offsets to such

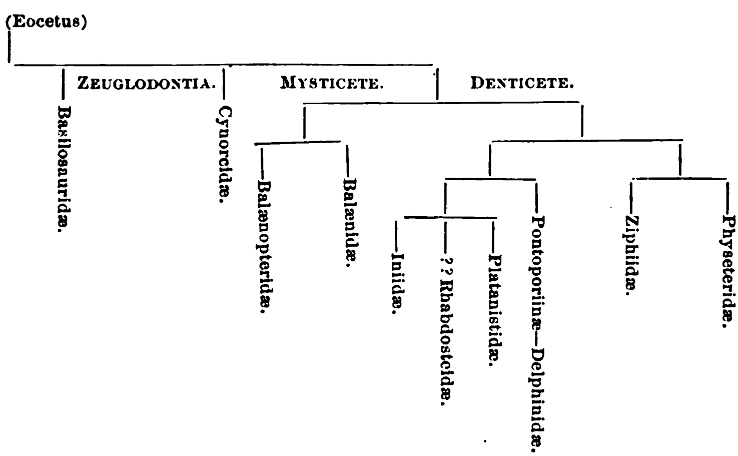
characters, and the rest of the organization is not in disaccord with those evidences of generalization.

On the whole, it appears to me that the long-necked Cetaceans represented by the living Iniids and Platanistids and in greater number by various forms in the Tertiary epoch are best entitled to the first rank. Whether of those, the Iniids or the Platanistids are the first is equally uncertain, but as the latter are certainly in some respects the most specialized, to the Iniids may be conceded the rank provisionally.

Probably, as more differentiated offshoots from the same secondary stem as the Iniids and the Platanistids, may be considered the Delphinids, of which the Pontoporiinæ doubtless represent the most generalized form.

Recommencing with the other secondary stem, apparently the Ziphiids represent the oldest rank, and the Physeterids are the results of an offshoot from the same lineage.

I have thus endeavored to present my views, and I trust that the language I have employed may prevent me from being misunderstood to mean that any one of the known specialized forms is derived from another of the known specialized forms. I have simply essayed to indicate what now appear to me to be the proximate relations of the several forms, and respectively the more generalized of the approximated groups. The following table may more vividly convey my views; in each case, the left branch indicates the supposed most generalized and the quasi-oldest form:



I shall only add that I have no intense convictions of the correctness of this representation, and regard it as simply provisional and subject to the modifications which the accumulating testimony now being so rapidly wrested from the living and the dead may necessitate. I do believe, however, that it is not in opposition to the data which have up to the present time been collected and tabulated. The advantages of such tables, in bringing into synoptical form and impressing upon the mind the various degrees of relationship and subordination of the respective subdivisions of a group, appear to me to be equally obvious (although not equally pregnant with meaning), whether we are evolutionists or patternists.

Remarks on Dr. Brandt's classification.—A few words on nomenclature and on the subfamilies of Mysticetes may be advisable.

Dr. Brandt* implies censures, by an exclamation mark (!), on the name Mysticete, and the inference conveyed thereby, and by his language, would be that I was responsible for the introduction of the name. As to the name itself, I perfectly agree with Dr. Brandt that it is objectionable and I hesitated sometime before adopting it. It was, however, the first introduced (by Gray, in 864†) and for that reason and that alone, I have employed it. It seems strange that Dr. Brandt should have been ignorant of this previous introduction, as he has referred to Gray's works in his memoir. I adopt very many names that are objectionable to me, recognizing as I do the inexorable demands of priority,‡ nor do I consider it necessary to protest against every inapt or ungrammatical name thus adopted, or found in the works of others, such, for example, as *Kyphobalæna* and others adopted by Dr. Brandt. §

As to the subfamilies, Dr. Brandt has suppressed those admitted by myself and others among the Balænopterids adding, however,

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* Eine dritte, neueste, von Th. Gill vorgeschlagene, Classification der Bartenwale, die er *Mysticete* (!) nennt, etc.· Brandt, Mel. biol., viii. 317.

† Gray, Proc. Zool. Soc. 1864, p. 198. It is true that Brisson had before called the same group *Cetacea edentula*, and Wagner, *Cetacea edentata*, but neither of those names fulfilled the requisites of nomenclature.

‡ Lest I may be here, too, misunderstood, I add that I simply recognize the rule of priority because of the advantage afforded as a basis for uniformity of nomenclature, and am not influenced in the slightest degree by any considerations of "honor" or "justice" to nomenclators.

§ *Cetotherium*, *Cetotheriopsis*, etc., are employed in the same memoir by Dr. Brandt.

two for extinct types, *Cetotheriinæ* and *Cetotheriopsinæ*. But while suppressing the subfamilies, he has retained the characters, the want of which induced me to frame one of them, in the diagnosis of the family itself. In other words, the subfamily Agaphelinæ was named for forms of Balænopterids distinguished by the absence of pectoral folds and of a dorsal fin, yet Dr. Brandt, while suppressing it as unworthy of subfamily distinction, considers the development of such folds and of a dorsal fin as family characters.* The development or not of the folds and fin is certainly not of family value and should therefore be eliminated from the definition of the family, as it misleads both as to the prevalence of the characters and their value, and at the same time diverts the identifier from the path. Whether the characters are of subfamily value is another question, and one which need not be discussed here.

In conclusion, it appears that I share the opinions of Dr. Brandt on most of the questions discussed, and I am happy to find that I can enroll myself under the banner of so able a leader; and I decidedly protest against being held responsible for views which I am as willing to oppose as he. As to the other points in which we appear to differ, I am fain to believe that it is due to the use of language more comprehensive than was meant by Dr. Brandt, and with the disposition to exercise that allowance for ambiguity which I would wish to have practised in respect to myself, prefer to surmise his real views from the general tenor of his works and thought, than to accept his exact phraseology.

REVIEWS AND BOOK NOTICES.

ARCHÆOLOGICAL COLLECTIONS IN AMERICA.—The recent report† by Prof. J. Wyman on the specimens received by the Peabody Museum in Cambridge is a most instructive document, as it not only gives a list of the additions made to the Museum during the year but also contains much interesting information relating to

* Pectus et abdomen sulcis longitudinalibus exarata. Pinna dorsalis perfecta vel tuberculo repræsentata.—Brandt. Mel. Biol viii. 320; see also p. 321.

† Fifth Annual Report of the Trustees of the Peabody Museum of American Archæology and Ethnology. Presented to the President and Fellows of Harvard College, May 15, 1872. 8vo pamphlet, pp. 35. Boston, 1872.

the specimens received; combining many notes by the eminent curator of the museum, suggested while comparing and arranging the immense collection which has been gathered by the careful management of Prof. Wyman and the other trustees of the museum. When the building fund shall have accumulated to an amount sufficient to enable the trustees to erect a proper building in which to exhibit the treasures in their charge, there will be opened a museum of archæology and ethnology that will have but few rivals in size and excellence. The foresight exhibited by the trustees, in obtaining the large and valuable foreign collections as they have been offered for sale, has secured the means of direct comparison of the relics of the prehistoric races of the old world with those of the new. Prof. Wyman remarks, when speaking of the Clement collection, the balance of which was received during the past year:

"The Museum may be considered fortunate in its acquisitions pertaining to European Archæology. With that of Clement from the Swiss lakes, that given by the Museum of Comparative Zoology from the same source, and to be mentioned further on, that of de Mortillet from France, Switzerland and the Italian lakes, with the admirable and very complete collections by Wilmot J. Rose from Denmark, Schleswig and Holstein, and with that of Claus from the same countries, we now possess good means for the study of European Archæology, and for the comparison of the implements and objects belonging to the early age of man in Europe, with the analogous ones of the new world. In view of the fact that there exists a large demand for archæological objects in the principal museums of Europe, that the Danish government prohibits the exportation of such, that the ancient dwelling places on the Swiss and Italian lakes, as also the caves and rock shelters of France, have been largely explored, and many of them exhausted, it is hardly probable that opportunities for obtaining collections, such as those above referred to, will be again offered to us."

In regard to the collections from America the trustees have been equally active and have received many valuable additions, especially from the labors of Rev. E. O. Dunning in East Tennessee, and those of the curator himself in Florida, beside the direct donation of many specimens from various parts of the country, including over eight hundred specimens from New Jersey presented by Dr. C. C. Abbott, who has also done so much for the archæological department of the Academy at Salem.

In his remarks on the Clement collection, Prof. Wyman makes many allusions to the similarity of the specimens with those from

this country, and when mentioning the great numbers of antlers of deer and the implements made from them, states:

"It is worthy of notice that in this collection a large part of all the antlers in which the base remains, were not such as came from animals killed in the chase, but such as had been dropped at the period when they were annually shed, as appears from the peculiar surface of the bone on the line of separation due to absorption. The horns of the deer seem to have been as great a mine of material to the lake dwellers for the manufacture of useful articles, as flint to the ancient inhabitants of Denmark, stone to the North American Indians, or bone to the Esquimaux and the natives of the northwest coast of America."

To show that similar results are attained generally by similar means, we quote a few lines on the drilled stones from the Clement collection:

"The method of drilling is well illustrated in a variety of instances, some showing the action of a solid, and others of a hollow rotary drill. Some of the last were not finished, but broken perhaps in the act of making, and the place from which the core was detached is quite obvious. A few of the cores are preserved. We thus have, as Mr. Rau has pointed out, processes of drilling parallel to those used by the Indians of this continent."

We may add that in the Academy collection there is a specimen received from New York, which shows the core about a quarter of an inch high standing up from the bottom of a hole that had evidently been drilled for two or three inches by a hollow drill before the specimen had from some cause been broken.

The letter of Mr. Dunning relating to his explorations in Tennessee and the account given by Prof. Wyman of the specimens collected are of great interest to the students of American archæology, and correspond in several respects with the account given by Dr. Jones in a former number of this journal. Among the most interesting relics found in the Tennessee mounds were a number of carved shells which Prof. Wyman describes in his report, of which we hope to be able to give figures in a future number.

As an instance of the acute examination which the curator gives to the specimens that come under his charge, we quote the following remarks on pottery ornamentation:

"A large proportion of all the vessels as well as fragments are in one way or another marked with the impressions of twisted cords. Similar markings have been observed on pottery from very distant parts of the United States, and have been observed on the

earthen vessels of the prehistoric period of the old world. We have specimens from Maine, Massachusetts, Missouri, Illinois, Ohio, Tennessee and Florida. It is an interesting fact that, while every trace of the cords and woven textures made by the mound-builders has perished, we have impressions or casts of the first left with sufficient distinctness on their earthen vessels to determine the style of twisting and the number of strands, and of the second to ascertain, in some cases, at least, the manner in which the cords were interwoven. By means described further on, the exact structure of the impressing surface has been reproduced. The explanation usually given of these markings is that the vessels have been moulded in a net, which was used to support the soft clay while the process of manufacture was going on. That vessels, especially larger ones, were moulded in baskets, and these destroyed in the burning, there is an abundance of evidence, as set forth in Mr. Rau's interesting paper on the pottery making of the North American Indians in the Smithsonian Report for 1866. This is a point about which there is scarcely any liability to error. But there is a great difference between moulding a vase in a firm and steady structure like a basket, and a yielding, flexible one, like a net. None of the specimens we have thus far received show that a net, if by net is understood a structure formed of meshes made by knotted cord, was used in moulding a vessel, for no impression of a knot is to be found anywhere. It would have been if any existed, as we have shown experimentally. The impressions are, in all cases, either of a *woven* texture or else of cords neither knotted nor woven but probably wound about some body, and in this form used as a stamp. By making casts of the surface of the cord-marked vessels with gutta percha, we have reproduced the original details of the impressing surface, which show very clearly the above differences. The textures are of two kinds, one with and the other without open meshes. The first are formed by a series of parallel cords or warps, intersected by a second series of parallel cords crossing the first at right angles, but including one of these in every twist of its strands. The laborious process was therefore required of passing the two strands of which the second cord is made above and below the first cord, and then twisting them before passing to the next. The texture with closed meshes is handsomely woven, and in one instance of threads not exceeding a thirtieth of an inch in diameter. Unfortunately, none of the vessels bearing markings of a woven texture are entire, so that it is impossible to ascertain whether the impressions are distributed in a uniform manner over the whole surface. It seems incredible that even an Indian would be so prodigal of time and labor as to make the necessary quantity of well twisted cord or thread, and weave it into shape for the mere purpose of serving as a mould, which must be destroyed in the making of a single copy. It must be remembered that the vessels are all made with bodies more or

less bulging or spherical, and that in consequence, if formed in a mould, this must either be made in sections capable of being separated, or else it must be destroyed either by cutting or, as is more commonly supposed, by burning, before the copy could be removed. There appear to be no traces of sections, and the impressions show no signs of a mould adapted to removal. Possibly the vessels thus ornamented were intended only for special purposes, as for religious ceremonies or the use of chiefs, and were not made in very large numbers, and so an unusual amount of labor might be accounted for. The second form of cord marked pottery is more common, and is very easily understood. The cords were arranged for the most part parallel to each other, and not connected either by weaving or knotting. We have reproduced such impressions by winding a cord around a stick, and pressing this against the surface of the clay, stamping only a limited surface at one time. In order to cover the whole surface in this way it would be a matter of nécessity that adjoining impressions would interfere with each other more or less, which they actually do on the surface of the vessel, one set partially obliterating another. Such impressions must therefore be regarded as finishing touches after the vessel was formed rather than as casts of a mould in which they were supposed to be made. This view is sustained by the fact that they often extend on to the handles, which are never added until the body of the vase is completed, and also by the fact that some of the impressions are but faintly made, as if the clay had already become somewhat hardened before the cords were applied. In one case the impressions were such as would be made by a ball of loosely wound cord, rolled over the surface. We are unable to say whether such markings had more than an ornamental signification, but it is worthy of notice that they were so largely used in widely different parts of the country. We saw similar markings on a vase in the Museum at Berlin, marked as to its origin *unbekannt*, unknown, in which the cord marks were arranged in a few horizontal circles and vertical lines, obviously taking the place of the ornamental lines usually traced with a pointed instrument. Sir John Lubbock mentions the existence of vases from ancient mounds in Scotland, ornamented with impressions from twisted thongs, and further states that in the stone age 'the most elegant ornaments of their vases are impressions of the finger nail, or of a cord wound round the soft clay.' Smith. Rep., 1862, p. 320. In view of these facts the question arises whether the impressions of the finer woven fabrics may not have been also merely ornamental markings added after the vase was completed, and not impressions of a mould in which they were formed."

In recording the collection made by Mr. Dunning from the burial caves in Tennessee, first noticed by Dr. Jones in the Naturalist, Prof. Wyman says:

"A second cave is situated near the mouth of the Big Pidgeon River, not far from Newport, in Cocke County. As described by Mr. Dunning, 'it is about eighty feet above the water, and reached only by a steep rocky path called Devil's Gap. The tomb was found about two feet below the floor of the cave, covered with an artificial layer of clay about six inches in thickness, by which the joinings of the stone were completely closed. It was five feet long, two high and three and a half broad, and built of unhewn stones, fragments of the outcropping limestone ridge near by. The body was placed in a crouching position. Charcoal and ashes were present, indicating that fire had been kindled near the tomb. The only relics found buried with the skeleton were about five pounds of disks made from some large marine shell from an inch to an inch and a half in diameter, and perforated in the middle.' The skeleton found in this stone tomb, as appears from the imperfect ossification of the bones, was that of an individual not quite adult, having a height of nearly six feet, but with bones of rather slender make. The tibiæ are somewhat flattened, and the fore arms are much lengthened, in proportion to the upper arm, the radius being 0·81 and the ulna 0·87 of the length of the humerus. The cranium was not quite perfect, but sufficiently so to determine its principal proportions. The most marked feature, and this is very striking, is the extreme artificial flattening of the occiput, and the consequent increase of the diameter of the head from side to side, so that the breadth somewhat exceeded the length, a degree of distortion not often met with even in the extreme cases among the Peruvians. In many of the North American Indian tribes a comparatively slight amount of distortion is often met with, but among a few it was carried to an extreme condition, as in the Natchez, as recorded by Adair and Bartram, and more recently by Morton; among the Choctaws and Waxsaws, according to Lawson, and among the Catawbas, according to Morton."

It is interesting to know that we have the flattened form of head in the ancient race of Tennessee as well as the natural form, for in a skull which Dr. Jones obtained from East Tennessee, of which we have a photograph in the Academy collection, the high forehead is a marked feature, and it seems now to be a fact beyond dispute that both forms of crania, as expressed by the terms of high and low foreheads, are common throughout the whole mound region of the United States, indicating a great similarity with the ancient races in Central and South America.

The third section of this interesting report contains an account of Prof. Wyman's own explorations in Florida. The care with which the professor renewed his examination of the shell heaps he had formerly so faithfully explored is most valuable in giving unques-

tionable data to other explorers. We have not space now to quote from this part of the report except so far as relates to the age of the mound at Silver Spring, a large shell heap of from two to twenty feet in height and said to cover an area of about twenty acres. This heap is made up almost entirely of the small fresh water shells of the genera Ampullaria and Paludina, and, as Prof. Wyman remarks, it seems incredible to conceive that such vast numbers of small shells could have been brought together by man from the waters about, and the immense size of the mound must be regarded as the work of many years and probably of centuries.

"There is to be seen at Silver Spring a grove of live oaks, a few survivors of a race of giants once common in the forests near the river, and to which my attention was called by my friend G. A. Peabody, Esq. Six of these at five feet from the ground measured as follows: one thirteen feet, three fifteen, one nineteen, and one between twenty-six and twenty-seven feet in circumference. This last has been partially destroyed by fire, an act of vandalism committed for the purpose of collecting the moss hanging from its branches. The circumference was estimated from one-half of the trunk, all that now remains, but agrees closely with measurements made several years before by Mr. Peabody, when the trunk was still whole. These trees are not on the highest part of the mound, but on the slope farthest from the water. Excavations made beneath the largest of them showed that the tree was of more recent origin than the mound itself. If at the beginning of the second century of the life of the live oak there are twelve rings at least to the inch, then the above mentioned tree, having a semidiameter of fifty inches, would have an age of not less than six hundred years, and was near the beginning of the second century of its existence at the landing of Columbus. On the same basis of calculation, the least age of the mounds near Blue Spring, and at Old Town, would be about four hundred years. Though these estimates are to be regarded only as approximations to the truth, they, without doubt, carry back the origin of the mounds beyond the reach of history or tradition, and certainly one or two centuries before the discovery of America. Although they cannot be more recent than the trees growing upon them, they may have been, and probably were, finished long before the life of the trees above mentioned began."

Revision of the American or Tyrant Flycatchers.* — This revision of the *Myiarchi* is based upon all the accessible material

* Studies of the Tyrannidæ.— Part I. Revision of the species of Myiarchus. By Elliott Coues. Proc. Acad. Nat. Sci. Phila. 1872, pp. 56-81. July, 1872.

in this country, numbering over two hundred specimens, and comprising the entire suites of the Smithsonian Institution, Museum of Comparative Zoology, and Mr. Lawrence's collection, and an examination of the types in the collections of the Boston Society of Natural History and the Academy of Natural Sciences of Philadelphia, together with numerous specimens from other sources. In this paper Dr. Coues has adopted the "synthetic" method of investigation instead of the "analytic" which, up to the present time, has been so generally followed, especially by American ornithologists. It is hence a paper of unusual interest as fairly initiating a "new departure" in American ornithology. Dr. Coues here takes the "arbitrary" but apparently justifiable basis of predicating "'species'† upon specimens presenting any definite, constant, tangible characters whatsoever, that do not, so far as it appears, grade into the characters of other species;" of predicating "'varieties' upon specimens presenting indefinite and inconstant yet tangible characters that are seen to grade into the characters of other specimens;" of predicating "'synonymes' upon specimens presenting indefinite, inconstant, and intangible characters, due to individual peculiarities, or to age, sex, season or locality; as well as upon specimens presenting no special characters at all." His investigation of the genus has led him to the belief "that there are only four forms (*sic*) of Myiarchus that do not intergrade, and that are differentiated from a common original stock to such degree, or in such manner, that we cannot account for their respective peculiarities according to highly probable laws of geographical variation depending upon differences in food, climate, etc." He finds that the specimens examined by him "represent nine species, two of which present each three tangible varieties." These results are somewhat different from those reached by other investigators of the group, and in allusion thereto he observes: "though in the following pages I may appear to have 'unnecessarily,' if not unwarrantably, reduced the number of species, yet I am persuaded that no unprejudiced ornithologist could have reached different conclusions upon study of the same material. It may be well to remember that two hundred specimens of Myiarchus have never before been examined by one person at a *coup d'œil;* and I think that with two thousand

† Compare Bull. Mus. Comp. Zool., III, p. 127, July, 1872.

specimens instead of two hundred, I should not be able to establish as many species as are here allowed."

The species and varieties recognized are the following: 1. *Myiarchus validus*, known only from Jamaica. 2. *M. crinitus*, with three localized varieties, viz., *crinitus*, which ranges throughout the eastern portion of the United States and retires to Central America to winter; *irritans* (including *Mexicanus* and *Yucatanensis* Lawr.), inhabiting Central and South America to Paraguay and distinguished with difficulty from var. *crinitus; Cooperi* (*Tyrannula Mexicanus* Kaup) confined chiefly to southern and southwestern Mexico. 3. *M. cinerascens* (*Mexicanus* Baird), "one of the better marked species of this difficult group" inhabiting southwestern United States and Mexico. 4. *M. tyrannulus* (*ferox*, *Swainsonii*, *Panamensis*, etc. auct.) a homogeneous type, ranging over Central America and southwest to southern Brazil. 5. *M. phœocephalus* of Ecuador, suspected to be a local race of the preceding. 6. *M. Lawrencei* of Mexico and Central America. 7. *M. nigriceps*, of Central and northern South America; though a tangible species, regarded as "simply a geographical representative of *M. Lawrencei.*" 8. *M. stolidus*, a flexible species, with three insular varieties or local races: viz., *stolidus*, Jamaica, St. Domingo and Hayti; *Phœbe*, Cuba and Bahamas; *Antillarum*, Porto Rico and Tobago, the Porto Rican form being very strongly marked. 9. *M. tristis*, Jamaica. Not only have all these "varieties" ranked hitherto as species, but others reduced in this paper to synonymes have currently held similar rank.

Preliminary to a revision of the species, the leading features of the genus are clearly sketched, as distinguishing it among allied genera. It proves to be a not sharply defined group, "the genus so called" resting "upon no structural characters, while its synonymes are among the vagaries of ornithology." A few species usually relegated to other genera are shown properly to belong here, and the genus as thus defined is susceptible of a tolerably definite diagnosis. Before proceeding to an analysis of the species our author discusses other general matters relating to the subject, especially individual and geographical variation, and announces several propositions to which he invites serious consideration. The importance of some of these will warrant their repetition here as being an exposition of important facts and principles at present engaging the attention of ornithologists, and capable of wide application.

"The normal inherent variability, in size, of the whole bird and its members, is at least twelve per cent. of the mean. (This is independent of all extraneous circumstances.)"

"Size varies in direct ratio with the latitude of the breeding season."

"Size of peripheral parts, as compared with total size, varies in inverse ratio with the latitude of the breeding-place. (*Cf.* Allen, Bull. Mus. Comp. Zool. II, p. 229)."

Intensity of coloration varies in direct ratio with the temperature and humidity of the breeding-place. Moisture, however, intensifies color more than heat; aridity tones down color more than cold. Birds from hot dry places, therefore, are paler, *cœteris paribus*, than birds from wet places of the same or even lower temperature. (*Cf.* Allen, *op. cit.*, p. 239)."

"Variation, unconnected with age, sex or season, is in inverse ratio with the migration or changeable geographical distribution of individuals."

Other propositions are announced relating to variations dependent upon age and sex in the group especially under consideration. They all appear to have been strictly followed, and the conclusions thus reached seem to be in the main thoroughly tenable. The propositions relating to geographical variation, though as yet far from being generally accepted, we are convinced are well founded, as the more thoroughly they are tested the more fully are they confirmed.— J. A. A.

MONOGRAPH OF THE SPHENISCIDÆ.*—In this important memoir of forty-two pages we have one of the most valuable contributions to the literature of the *Spheniscidæ* that has yet appeared. It opens with a critical historical synopsis of all preceding papers treating of the group, from Linnæus down to the present year, in which are briefly yet lucidly traced the principal changes of synonymy and the gradual accumulation of our present knowledge of the family. From the two species known in 1766 to Linnæus, the number had increased in 1781 to eight valid species, four of which were then made known for the first time by Forster in his valuable history of the group. The next valid new species was described by Brandt in 1837, "the first for half a century." Later the number of valid species was increased to twelve, the number recognized by Schlegel in 1867, and by our present author. Respecting Schlegel's judicious revision of the group Dr. Coues observes; "As far as the determination of the species is concerned,

* Material for a Monograph of the *Spheniscidæ*. By Dr. Elliott Coues, U. S. A. Proc. Acad. Nat. Sci. Phil., 1872, pp. 170-212, with 8 woodcuts. (Sept., 1872.)

our own studies bear out Dr. Schlegel's in every single instance; indeed, it seems to us impossible to reach any other conclusion, when any considerable and sufficient amount of material is examined. The present article of ours is so completely an endorsement of Dr. Schlegel's, that the only points of difference are one or two unimportant synonymical determinations among the crested species which, after all, will probably remain matters of opinion."

The materials on which Dr. Coues' memoir is based are the collections of the Philadelphia Academy of Natural Sciences, (now for the first time elaborated), and of the Smithsonian Institution. Both are rich in representatives of this group, with which have been also collated the specimens in the Museum of the Boston Society of Natural History. Part II is devoted to a discussion of "certain points of cranial structure bearing upon the determination of the genera." Alluding to the diversity of opinions among authors in respect to the number of genera — some placing all in one genus and others making a genus of each species — Dr. Coues states that "to fix the question of genera with reasonable certitude" was one of the objects of his present investigation. An examination of the skulls at his command (but representing only a part of the species) showed "*three* positively different patterns." Each pattern, while marked by peculiarities of its own, possesses characters shared also by one of the others, and it is on the combination of these features that the genera are established. Whilst our author thinks it "probable that no more than three genera will be finally determinable, namely, Aptenodytes, Eudyptes and Spheniscus," he provisionally admits a fourth, Pygocelis. "These genera are exactly those of Prof. Hyatt," and "correspond very nearly with the sections Dr. Schlegel has indicated." In this connection the chief osteological peculiarities of *Aptenodytes* "*Pennantii*" are described, with more especial reference, however, to the membral segments. "The tarso-metatarsus," Dr. C. remarks, is the most remarkable bone of the skeleton in several respects, and the one more particularly diagnostic of the family; penguins afford probably the only instance, among recent birds, of width crosswise being decidedly greater than thickness antero-posteriorly, and more than half the length; and the only case of persistence throughout life of fenestræ marking the composition of the bones of three originally

distinct metatarsals." These membral and cranial features are illustrated by several figures drawn by Prof. Morse.

Part III treats briefly of the geographical distribution of the species. The penguins are not only confined to the southern hemisphere, but range northward only to latitudes 10° south on the Pacific coast of South America and to 8° south on the Atlantic coast of the same continent; on the African coast only to 25° south and occur only much further to the southward on the coast of Australia. The Falkland Islands appear to be the geographical centre of the family, where no less than half the species occur. They range southward, however, as far towards the pole as voyagers have yet penetrated. The species have usually a wide range, several of them being circumpolar; of none does the exact range of periodical movements or migrations appear to be known. In general they assemble in immense numbers at their breeding stations where they commonly remain for but a short portion of the year.

Part IV gives a list of the species, with their synonymy, and Latin diagnoses. The specimens examined are enumerated, and generally each is described more or less in detail, with special reference to an elucidation of the various stages of plumage each species presents. As we have already indicated, only twelve species are recognized, as follows: — *Aptenodytes Patagonica*, *A. longirostris*, *Pygocelis tæniata*, *P. adeliæ*, *P. antarctica*, *P. antipodes*, *Eudyptes catarractes*, *E. chrysocome*, *E. chrysolopha*, *E. diademata*, *Spheniscus minor*, *S. demersus*, *S. demersus* var. *Magellanicus*.

This elaborate memoir constitutes a valuable supplement to Prof. Hyatt's recent catalogues of the *Spheniscidæ*,* and must form for many years a standard work of reference for the group. Besides elucidating the complicated generic and specific synonymy of the family, it is a valuable contribution to our knowledge of the osteology of the penguins, and to their geographical distribution and changes of plumage during the period of adolescence.—J. A. A.

DUBOIS' CONSPECTUS.†— Lists of European birds seem destined to occur at frequent irregular intervals, and perhaps we cannot have too many of them, at any rate so long as they continue to agitate the subject by their notable mutual disagreements, and thus serve

* See Amer. Nat. Vol. VI, pp. 472, 515.

† Conspectus systematicus et geographicus Avium Europæarum; auctore ALPH. DUBOIS, etc., etc., Bruxelles, 1870. (8vo. pp. 35.)

to keep us alive to the requirements of the case. While we personally have not the particular information required for nicety of criticism in such an instance as the present, we may, nevertheless, indicate the general features of the paper. The author has limited his field to "Europe," politically speaking, as is customary indeed, but as is not, in our judgment, either necessary or desirable. As naturalists, we should consider the distribution of our objects of study with reference rather to natural faunal areas, at least when the species of more than a single locality are to be collated. We trust that the compiler of the next "European" catalogue will take this into consideration. Prof. Dubois catalogues five hundred and seventy-five species in gross, under two hundred and fifty-three genera of fifty families, this enumeration being exclusive of numerous "varieties," but inclusive of the "stragglers" (*fortuito occurrentes*). There are, we find, about one hundred and sixty-five of the latter, leaving four hundred and ten species net. Comparing this with a rather recent list * of very excellent authority, the discrepancy is notably slight, Prof. Blasius giving four hundred and twenty regular inhabitants, one hundred and three casuals and fifty-five varieties. The totals of the two lists (five hundred and seventy-five and five hundred and seventy-eight) are surprisingly close, but it should be remembered that this apparent agreement is largely brought about by accidental counterbalancing of numerous individual discrepancies; and furthermore, if Dr. Dubois had, like Prof. Blasius, numbered the geographical and other varieties he admits, the result would have been very different. On the whole, we cannot consider that European ornithologists have as yet reached unanimity in the cases of more than two-thirds of the species that occur within their limits. Whether the present list is more or less reliable than some of its predecessors, we must leave to the judgment of those who are better informed than ourselves; but there is no doubt of its very general acceptability.

Much may be said in general terms, in favor of the classification of this brochure, although we cannot endorse it throughout. We protest, as other writers have, against the "fissirostral" association which places swallows alongside swifts and goatsuckers; we see no grounds for the uniting of American *Tireonidæ* with the old world *Muscicapidæ*, nor the propriety of putting the nine-

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†Blasius; Newton's ed. of 1862.

primaried American *Sylvicolidæ* under *Sylviidæ*.* We have little faith in the desirableness of associating the cuckoos with the woodpeckers in a group *Zygodactyle*, greatly preferring Huxley's definition of the Coccygomorphs. In the matter of nomenclature we are not at one with the author, who goes back for his names to Ray, Gesner, Willoughby and Aldrovandi, to say nothing of the comparatively late Brisson and Moehring; but this is simply a matter of individual preference. Whatever "rules" may be made, they are only binding at our option — paraphrasing an old saying: *inter synonyma silent leges*.* *

[We take this occasion to request ornithologists to favor the NATURALIST with a copy of any paper they may hereafter publish; intending to devote reasonable space to the respectful consideration, at the hands of our ornithological co-laborers, of such publications.— EDS.]

NEW ENGLAND ORNITHOLOGY.— Mr. Maynard contributes a very acceptable and creditable paper,† increasing our knowledge of the summer northern distribution and breeding habits of many species of which comparatively little was before known; and gives good descriptions of various nests and eggs. The information respecting most of the land birds observed is quite full and apparently perfectly reliable. The species given number one hundred and sixty-four, which is probably about five-sixths of the whole avi-fauna of the regions explored. As the author confines himself to his own personal observations and those of a few gentlemen who have worked in the same or contiguous localities, the paper is notably free from misstatements of fact, although some of the generalizations seem to us somewhat overdrawn if not altogether hasty. We are unable to agree with Mr. Maynard respecting certain flycatchers which he discusses at length. He evidently labors under a misapprehension (shared, we understand, by other New England ornithologists) regarding *Empidonax Acadicus*. This bird, which appears to be hardly known in New England, is per-

*Respecting this family we are informed by Dr. Coues that he considers it inadequately distinguished from *Turdidæ*, viewing the annectant forms of the two families; and that the current *Turdinæ*, *Saxicolinæ*, *Regulinæ*, *Miminæ*, *Pycnonotinæ*, *Sylviinæ* (*Sylvia*, *Erythacus*, *Accentor*, *Calamoherpe Phyllopneuste*) should form one family, which may require to be further enlarged to accommodate the *Troglodytidæ* and *Motacillidæ*.

† A Catalogue of the Birds of Coos Co., N. H. and Oxford Co., Me., with annotations relative to the breeding habits, migrations, etc. By C. J. Maynard. Proc. Bost. Soc. Nat. Hist. xiv, October 1, 1871.

fectly distinct from *Traillii* and *minimus*, between which Mr. Maynard misconceives it to stand. As an example of the faulty reasoning with which we must charge the author, we may cite the case he presents of *E. minimus*. Finding *a certain amount* of variation in the proportions of the quills, he assumes that the wing-formula is *entirely* unreliable; which is not the case. If, for example, he had said of *E. minimus* "second, third and fourth quills subequal and longest, fifth little shorter, first and sixth subequal and shortest," he would have laid down a formula by which the species is always distinguishable from *Acadicus** (not from *Traillii*, however). Reverting to a matter of more consequence, we should note that in the localities visited by Mr. Maynard "the Alleghanian and Canadian faunæ meet. . . Starting on the northeastern coast of Maine, near Mt. Desert, the dividing line of these faunæ proceeds in a southwesterly direction along the southern margin of the mountain range which stretches across the state to the White Mountains. Here it declines to the south, reaching even to Rye Beach. Then once more proceeds northwest along the western borders of the mountain range into Vermont. . . So abruptly is the line defined in many places by the range of mountains, that some birds which occur in abundance on one side are found only as stragglers, or not at all on the other."

For the numerous typographical errors which deface the paper we understand that the author cannot be held responsible, since he had no opportunity of revising the proofs. The paper itself is such a forcible commentary upon the inexcusably faulty practice, by far too common, and quite needlessly so, of printing scientific matter without author's revise, that we refrain from the sermon which nevertheless we are strongly inclined to preach on this occasion. — E. C.

ANNALS OF BEE CULTURE.† — This annual contains several essays of great interest and value to bee keepers; they are all good, and some of sterling value, and apparently above the average of articles appearing in the ordinary bee journals. Its ap-

*The formula of *Acadicus* is: second and third quills subequal and longest, fourth little if any shorter, first and fifth subequal and much shorter, sixth much shorter still.

† Annals of Bee Culture for 1872. A Bee Keeper's Year Book. D. L. Adair, editor. With communications from the best American Apiarians and Naturalists. Louisville, Ky., 1872. 8vo, pp. 64.

pearance encourages us in the hope that bee keeping will be conducted on a more scientific basis than ever before in this country.

UNDERGROUND TREASURES; HOW AND WHERE TO FIND THEM.* The design of this little book is to make every farmer and landowner his own mining engineer, and when his knowledge is exhausted to induce him to go to some professional mining engineer for advice. Perhaps the recent diamond swindle demonstrates the need of just such a guide as this. The plan seems well carried out, the descriptions of minerals, ores and gems being terse and clear, and the hints as to how to find them are practical. After describing the eighty minerals which out of two hundred and forty-four found within the United States are of practical use, the author gives chapters on "Prospecting for Diamonds, Gold, Silver, Copper, Lead and Iron," "Mineral Springs," "Artificial Jewelry—How Made and How Detected," "Discovery of Gold in California," and a concluding one on the "Discovery of Silver in Nevada."

BOTANY.

PAST VEGETATION OF THE GLOBE.—Nine years after the publication of Brongniart's "Tableau" Dr. Paterson discovered, in a bituminous shale near Edinburgh, *Pothocites Grantoni*, which has been generally accepted ever since as a monocotyledonous flowering plant. It can therefore no longer be asserted that in the Palæozoic period the higher Phanerogams were absent. Nor can it be even said that, amongst Phanerogams, Pothocites belongs to a very primitive type. The condensation of its inflorescence and the reduced structure of its flowers imply, on any hypothesis of evolution, the previous existence of flowering plants which had undergone less differentiation. Indeed, for anything that can be positively said to the contrary, there may have been during the Carboniferous epoch a phanerogamic covering to the earth hardly less complicated than there is now. Our knowledge of the vegetation of that time is confined to the forests of arborescent Cryptogams fringing the deltas of great rivers. Stems of coniferous trees were occasionally floated down from the higher ground; of the plants that grew with them we know nothing.

*Underground Treasures: How and Where to Find Them. A Key for the Ready Examination of all the Useful Minerals within the United States. By Prof. James Orton. Illustrated. Hartford, Conn. Worthington, Dustin & Co. 1872. 12mo, pp. 137.

Still less can it be said of the Mesozoic period that its fossil remains convey any adequate notion of the contemporary *facies* of the vegetation. The cones and driftwood that occur in rocks of marine formation of this age would have been little injured by immersion in water in which the flowers and foliage of less rigid plants would speedily have decomposed beyond recognition. Such guesses as we can make about the actual vegetation of Mesozoic land surfaces stand in the same relation to the reality as do those which a traveller would make in approaching a new country from the ocean, and in collecting the vegetable waifs and strays borne out to sea by currents, to the estimate which he afterwards forms when he botanizes at leisure on the land itself. It is, however, only fair to admit that if arborescent Dicotyledons existed to any large extent anterior to the chalk, it is hardly explicable that we have as yet no evidence from driftwood that this was the fact, except Mr. Sorby's notice of some non-gymnospermous wood from the Lias near Bristol,* which appears to have been overlooked. In the "dirt-bed" of the Upper Oolite we have a true land surface, but the ligneous plants of this were undoubtedly gymnospermous. It is far from improbable however that, at any rate, herbaceous Dicotyledons had made their appearance in the Mesozoic period. Monocotyledons, as already pointed out, are certainly known to date from a time still earlier, and in the herbaceous condition Dicotyledons are less different from Monocotyledons than when they become woody. Several facts seem to prove that existing trees are more modern than herbaceous plants belonging to the same groups. They have, for example, more confined ranges, and often represent on oceanic islands, apparently because the exaltation of their stature has had less to struggle against, orders which elsewhere comprise only herbaceous plants. Probably in every group the arborescent habit has been a subsequent development. — W. T. THISELTON DYER in *The Academy*.

SEEDS AS PROJECTILES.—*Editors of Naturalist:* Allow me the favor to correct the phraseology I, by some unaccountable slip of the tongue, employed in referring to the Hamamelis seed. It is the contracting of the horny *endocarp* not the horny "albumen," which projects the seeds.—THOMAS MEEHAN.

* Transactions Microscopical Society, vol. iii, p. 91.

How the Buffalo Grass Disappears.—Prof. Mudge in an interesting letter in the "Kansas Farmer" on northwestern Kansas, gives some interesting facts as to the gradual disappearance of the buffalo grass and the incoming of other grasses before the advent of civilized men. He says:

"The steadiness and regularity of this change is interesting. Seventeen years ago the buffalo grass covered the hills and prairies about Manhattan, but it has been gone many years. Six summers ago, when we first visited the forks of the Solomon, we found it everywhere except close to the river bank. Two years later, the blue stems had possession of half the bottom. Now the buffalo grass has entirely left the latter ground, and is fast vanishing from the high prairie. In November, 1866, we visited Smith and Phillips counties, then unsettled, and found buffalo grass in full possession, but this summer it had disappeared to the extent of one-half in the bottoms, and the tall grasses had become intermingled with it. On the high lands the change had already begun, but to a limited extent. On the Prairie Dog and at the upper portions of the Middle Fork, we found the change just commencing. In crossing from Cedarville to Bull City in Osborne county, we noticed that the buffalo grass had left the divide to the extent of one-third, and the coarser grasses above named had taken its place.

We thus record a few of these changes, that others may notice the regularity and rapidity of the disappearance of the buffalo grass."

Hepaticæ Cubenses Wrightianæ. — Under tickets with this heading Mr. Charles Wright has distributed a few sets (varying from two hundred to one hundred and fifty species) of *Hepaticæ* collected by him in Cuba several years ago. They have in the meantime been studied by Gottsche of Altona, who is the principal authority in Hepatic mosses, and are named by him. The authentic names are given upon the tickets. The sets are to be disposed of, at ten dollars the hundred specimens, upon application to Mr. Wright, at the Herbarium of Harvard University.

A Grand Herbarium. — The herbarium of Columbia college, New York, is to have added to it the immense collection of Dr. Meissner, the distinguished Professor of the University of Basle. This herbarium contains 63,000 species, and is purchased for the college through the liberality of J. J. Crooke, Esq., a wealthy amateur scientist. The present herbarium of the college is the invaluable one of Dr. John Torrey, and is especially rich in

typical specimens. With the proposed addition it is said that it will be the largest herbarium in the country.

ZOOLOGY.

CEMIOSTOMA AGAIN—In my note *ante*, p. 489, I have stated that in the "Transactions of the London Entomological Society" Ser. 2, vol. 5, pp. 21 and 27, and in Ser. 3, vol. 2, p. 101, certainly two, and if my memory serves me aright three, species of Cemiostoma have been described from India. These references were evidently made from memory. It seems from Mr. Mann's note *ante*, p. 606, that but two species are mentioned on the pages referred to and those two are from England, not from India. Nevertheless, I am still convinced that my memory is not utterly at fault, and that species of Cemiostoma have been discovered in India, and when the opportunity again offers I will look them up. Many months had elapsed after I saw the "Trans. Lond. Ent. Soc." before my note on p. 489 was written, and probably I have confounded in my mind the above references with some other. Eastern naturalists surrounded by fine collections, libraries and every facility for study can scarcely appreciate the difficulties with which their less favored western brethren have to contend; and Mr. Mann no doubt learned whilst in Brazil that want of the means of reference to what others have done is a very different thing from "negligence."

Cemiostoma, Phyllocnistis, many species of Lithocolletis and a few other genera of Tineina have a spot *in the apical part* of the wing which I have therefore called "the apical spot." In Phyllocnistis and in Lithocolletis this spot is always *at* the apex: but in Cemiostoma it is always at the inner angle. So characteristic of each of these genera is the position of the spot in it, that when the name of the genus is given and its spot is mentioned, the student who is familiar with the genus knows at once where the spot is located; just as Mr. Mann knew at once from my description the location of the spot in *C. albella*, although he had never seen the species and although I called it, for brevity, and not through negligence, "the apical spot" instead of "the spot located at the inner angle." But if the phrase "apical spot" might have been misleading had it stood alone, it could not have been so in the description of *C. albella*, because it is connected with the state-

ment that "*behind it at the base of the cilia* is a fuscous streak" showing that the "apical spot" was not at the extreme apex.

C. susinella, *C. coffeella* and *C. albella* are evidently very nearly allied, if they are not in fact different names for the same species. All of Mr. Mann's figures in his last plate will answer *for some specimen of albella*, especially the figure of the cocoon. The mode of pupation is the same, and I have been able to detect no differences in the larvæ. *C. albella* and *C. susinella* mine the leaves of poplars, and *albella* also mines those of willows; whether *susinella* does is not ascertained. The identity of the food plant, and the close similarity of the insects, raise a strong presumption that they are the same species. But *albella* has the tuft on the vertex as distinct as it is in *coffeella*, whilst Mr. Stainton says that *C. scitella* was (when he wrote) the only European species which has such a tuft, and if so, then *susinella* must be distinct from both *albella* and *coffeella*. But Mr. Stainton's note upon *susinella* is very brief and he does not pretend to give an accurate or detailed description of it. Besides, it has not yet been found in England, and Mr. Stainton's specimens must have come from Europe, and therefore may be a little worn, and the tuft is very easily obliterated. Mr. Stainton's brief note, then, scarcely affords sufficient data for a comparison with other species. He says that *susinella* has two fuscous streaks pointing upwards in the cilia, represented, as I infer, by the last two streaks in Mr. Mann's figure; and *susinella* and *coffeella* therefore do not differ in this respect; but in *albella* the first of these last two streaks, that immediately behind the "apical spot," is only fuscous at the costa and the remainder of it is pale golden. The outer fuscous stalk is represented in *albella* by the fuscous spot at the apex, and with the cilia expanded as in flight this spot would become a streak. In *coffeella* the spot is partly surrounded (on the sides towards the base and towards the costa) with pale golden. Mr. Stainton does not mention this golden margin, but he says that the first (golden) costal streak is continued to the anal angle (where the spot is), and if so, it must partly surround the spot. Mr. Mann represents the two golden costal streaks as not attaining the spot, and not confluent with its golden margin. My description of *albella* was drawn up from four specimens in which I failed to detect the presence of the golden margin around the spot thus differing from *coffeella* and in which the golden costal streaks did not attain the

spot thus agreeing with *coffeella* and differing from *susinella.* Since the description of *albella* was written I have obtained many specimens and find a greater range of variation than I then supposed to exist. In some specimens the golden margin around the spot is only visible in some lights, in others it is distinct and wide, so as to be confluent with both golden costal streaks, and I have a specimen in which this is the case as to one wing, whilst on the other both streaks are entirely distinct from the golden margin of the spot. If the same range of variation exists in *coffeella* and *susinella* I do not see how they can be regarded as distinct species, nor wherein they differ from *albella* except that in *albella* the ciliary streak is golden, except on the costa where it is fuscous, whilst in the other two species it is said to be entirely fuscous. Possibly, however, they may differ as to the spot itself. For Mr. Stainton says that in *susinella* the spot is black with a violet ocellus, whilst in *albella*, although the color varies with every change of the light, I would not call the central part of the spot an ocellus at all, nor its color violet; but would rather consider the spot as brilliant silvery, or silvery-gray, metallic, margined distinctly with black before and behind, and but faintly or not at all above and beneath. I doubt, however, the specific difference of the specimens, and if they are distinct the difference can probably only be determined by a comparison of a large series of specimens of each.— V. T. C.

GEOLOGY.

PROBOSCIDIANS OF THE AMERICAN EOCENE. CORRECTION.— Having for the first time obtained a view of the premaxillary and maxillary bones of the *Eobasileus cornutus*, I find that the tusk which I have called an incisor is a canine.— E. D. COPE.

RETURN OF THE YALE COLLEGE EXPEDITION.—Professor Marsh and party returned on the 7th of December from the Rocky Mountains, where they have spent the last two months in geological researches. They bring back a large number of vertebrate fossils from the Cretaceous and Tertiary formations of the West, including many new and interesting mammals, birds and reptiles. Among the treasures secured during the present trip was a nearly entire skeleton of *Hesperornis regalis* Marsh, the gigantic diving bird of the Cretaceous; a second species of *Ichthyornis* (*I. celer*

Marsh), and numerous remains of Pterodactyls. The new fossils will soon be described by Professor Marsh.

NOTICE OF A NEW AND REMARKABLE FOSSIL BIRD.—One of the most interesting of recent discoveries in palæontology is the skeleton of a fossil bird, found, during the past summer in the upper Cretaceous shale of Kansas, by Prof. B. F. Mudge, who has kindly sent the specimen to me for examination. The remains indicate an aquatic bird, about as large as a pigeon, and differing widely from all known birds, in having *biconcave vertebræ*. The cervical, dorsal and caudal vertebræ, preserved, all show this character, the ends of the centra resembling those in *Plesiosaurus*. The rest of the skeleton presents no marked deviation from the ordinary avian type. The wings were large in proportion to the posterior extremities. The humerus is $58 \cdot 6^{mm.}$ in length, with the radial crest strongly developed. The femur is small, and has the proximal end compressed transversely. The tibia is slender, and $44 \cdot 5^{mm.}$ long. Its distal end is incurved, as in swimming birds, but has no supratendinal bridge. This species may be called *Ichthyornis dispar*. A more complete description will appear in an early number of this Journal.—O. C. MARSH, *American Journal of Science and Arts.*

KNOWLEDGE OF PETROLEUM IN PENNSYLVANIA IN 1771.—On page 638 of the October number of the NATURALIST is a notice of the fact that petroleum was known to exist in Pennsylvania in the last century, and the date given was about 1789. I have in my library "Kalm's Travels in North America" in which is a map "published according to act of Parliament, March 7, 1771," upon which I find marked "petroleum" on the Alleghany River about eight miles above the mouth of French Creek. The locality is marked with a little cross (+) on the east bank of the river, which would put it very nearly opposite to the mouth of Oil Creek as now known. I also find on the same map, in what is now Ohio, in the vicinity of the present location of New Philadelphia in Tuscarawas County, "Coals and whetstones:" and on the Hocking River near the southern portion of the state is found the word "coals."

Kalm makes no mention of either coals or petroleum in these localities; in fact, he did not himself travel so far to the west, but the fact of these names being on a map published in 1771 shows

that they must have been known for a considerable time prior to that date. — C. E. BESSEY.

ON AN EOCENE GENUS ALLIED TO THE LEMURS. — Professor Cope recently read a paper before the American Philosophical Society on an extinct mammal from Wyoming which he called *Anaptomorphus æmulus*. The number of teeth in the lower jaw is precisely the same as in man and the higher apes, but their structure is nearer that of certain Lemurs at present existing in Madagascar and East Africa. This resemblance is closer than has yet been discovered to exist in any fossil genus, but is somewhat diminished by the separation by suture of the two halves of the lower jaw. The animal was as large as a squirrel.

FOSSIL MONKEYS. — Dr. Forsyth Major has just published in Italy an account of certain fossil Simian remains which have lately been for the first time discovered in Italy, and which he refers to a species closely allied to the Barbary ape, *Macacus inuus*, still found at Gibraltar. To this account the writer appends a history of all fossil Quadrumana at present known. Of these, seven species belong to Pliocene and Quaternary, ten to Miocene, and three to Eocene strata. No fossil Lemuridæ have yet been discovered; the fossils as yet found in S. America belonging to the Platyrrhini, still peculiar to the Neotropical region. All the rest belong to the Catarrhini, and some to the anthropomorphous genera; these have all been found in the old world, but while some occurred in India, others inhabited France, Germany, Greece and England. — A. W. B.

ON SOME OF PROFESSOR COPE'S RECENT INVESTIGATIONS. — In the NATURALIST for November last (p. 669), Prof. E. D. Cope has a paper on the "Coal Beds of Wyoming," in which he claims to have made the discovery that these strata are of Cretaceous age. This, however, was already known to every one familiar with the geology of that region. The existence of Cretaceous coal in various parts of the Green River basin had previously been established by Mr. Meek, Messrs. King and Emmons, and myself, although Professor Cope makes no reference to our researches. Any one wishing to consult the recent literature on this subject will find it cited in the "American Journal of Science" for December 1872, page 489.

In the December NATURALIST (page 773), there is another paper by Prof. Cope on the "Proboscidians of the American Eocene." The discoveries here claimed rest on an equally unsatisfactory basis. The species mentioned had apparently all or nearly all been previously described by Dr. Leidy and myself, the type species, *Tinoceras anceps* Marsh, dating back to June, 1871. Some of the characters given by Prof. Cope, *e.g.*, the large upper incisors and absence of canines, do not, indeed, apply to the species I have described; but I feel quite sure that Prof. Cope's haste has unfortunately led him to mistake canines for incisors. On several other points, especially the position of the horns and structure of the skull, I believe Prof. Cope to be equally wrong. The animals described evidently belong to the order which I have called *Dinocerea* (Amer. Journ. Sci., Oct. 1872, p. 344). Their true characters and affinities, I propose soon to discuss fully elsewhere.—O. C. MARSH.

DISCOVERY OF EXTINCT MAMMALS IN THE VICTORIA CAVES, SETTLE, YORKSHIRE.—This famous bone-cave has hitherto produced only remains of different ages from the Neolithic period to the present. Recent excavations have yielded, however, at the depth of about twenty feet, bones of the elephant, rhinoceros, hyena, a crushed canine of a much larger carnivore, etc. The elephant's teeth found belong to a young individual, and the number of gnawed bones and other indications, that the cave had been a den of some larger carnivores, render it probable that the elephant was dragged into it by them.—A. W. B.

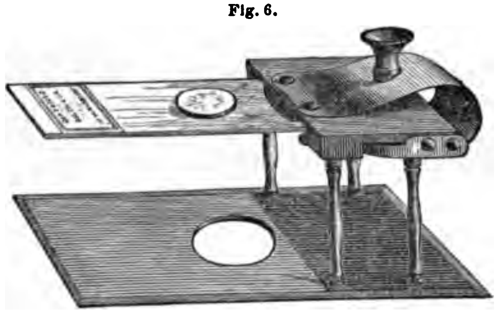
MICROSCOPY.

MICROSCOPY AT THE VIENNA EXPOSITION.—The Exposition of the Industry of all nations to be held in Vienna this year, will afford microscopists a rare opportunity to exhibit to the world the results of their ingenuity in contrivance, or of their skill in construction, of microscopical apparatus and appliances. General T. B. Van Buren is Commissioner General for the United States, and President F. A. P. Barnard is chairman of the Advisory Committee on Group XIV, in which are included optical instruments. Persons desirous of contributing to the exhibition of American art on this occasion are requested to communicate immediately with any of the following persons who are the microscopical

members of the committee; Profs. R. H. Ward, M.D. of Troy, New York, H. L. Smith of Hobart College, Messrs R. B. Tolles of Boston, Mass., W. S. Sullivant of Columbus, Ohio, J. B. Rich of New York City, William Wales of Fort Lee, New Jersey, Charles A. Spencer of Canastota, New York, Joseph Zentmayer of Philadelphia, Pennsylvania, and J. Grunow of New York City.

A New Accessory Stage. — Messrs. James W. Queen & Co., of Chestnut Street, Philadelphia, and Broadway, New York, have contrived a stage which can be used with any microscope and which will commend itself to many microscopists as a very useful accessory. It consists of a brass stage-plate, perforated in the centre for the transmission of light and bearing, at one end, four pillars which support, at the height of about an inch, a second plate. To the under side of this second plate the object-slide is attached by

Fig. 6.



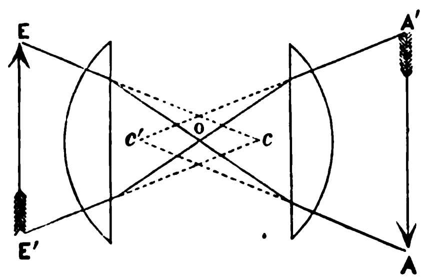
means of slight springs which allow it to be easily misplaced. It is evident that this contrivance admits of any degree of obliquity of illumination without regard to the construction of the stand on which it is used; and the slight awkwardness of adapting an achromatic condenser to this apparatus is nearly negatived by the fact that most microscopists prefer to obtain extremely oblique illumination either by a prism, or directly (unmodified) from the source of light, for both of which this arrangement is especially available. The comparative safety of the thin glass cover over the object will also be appreciated by the many persons who have seen a rare or costly object, such as the Type Plate, or Nobert's Lines, ruined by an incautious touch of a high power objective.

Magnifying Power of Objectives. *To the Editors of the* American Naturalist. Dear Sirs: — With great interest and pleasure I have followed the preliminary movements to establish a

uniform nomenclature of the value of achromatic objectives for the microscope, to which the foremost microscopists of our country and abroad have advanced their contributions.

The problem is a complicated one, and the following will by no

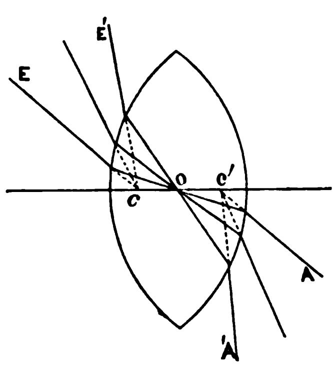
Fig. 7.



means diminish the practical difficulties, but will only add one more which has not been brought into consideration.

Undue importance is given to the optical centre of a lens, or combination of lenses, by the different writers upon the subject, while the great importance of the conjugate centres of a lens has been entirely neglected. The conjugate foci of a lens or combination of lenses, are in no way dependent on its optical centre, but entirely on the conjugate centres. The single plano-convex lens makes an exception: for in this the optical centre and the conjugate centres fall together, where the optical axis meets the curved surface.

Fig. 8.



If we take, for instance, a double convex lens of equal radii, Fig. 7, its optical centre is O, and consequently the rays A′ and A, striking the lens at such angles as to pass through the optical centre, will emerge at E′ and E, parallel with the first directions. If now the rays A′ and A are prolonged towards the optical axis

of the lens, they meet at a point, C′, the centre of admission. If the rays E′ and E are prolonged, they will meet at C, the centre of emission. Therefore the conjugate foci do not meet at the optical centre O, but are to be measured from C′ to the object, and from C to the image; and the sum of the conjugate foci is *not* equal to the distance between object and image, but in this case the distance between C and C′ must be deducted.

In combinations of lenses it is precisely the same. It is almost impossible to analyze such a complicated system as a modern microscopical objective, and to fix the position of the optical centre or the conjugate centres, although all combinations possess these remarkable centres. But let us take a simple combination of two plano-convex lenses placed symmetrically, in which it is not difficult to determine all that we need. In such a combination, Fig. 8, the rays A and A′ pass through the optical centre O, and emerge to E and E′, parallel with their original directions. Now if we prolong A and A′, they will meet at C′, the centre of admission; and E and E′ prolonged will meet at C, the centre of emission. To find for this combination the relation of conjugate foci, or the relation between the size of object and image, we have to compare the triangle ECE′, with the triangle A′C′A. In this case the sum of the conjugate foci is equal to the distance of object and image, plus the distance from C′ to C. In combinations this will generally be the case. — JOSEPH ZENTMAYER, *Philadelphia, Sept. 25th*, 1872.

AMPHIPLEURA PELLUCIDA BY MOONLIGHT. — Many microscopists have had the curiosity to use the beautiful white light of the full moon as a source of microscopical illumination, but probably few have tried it upon the more difficult objects. Prof. T. D. Biscoe, led on by the clear sharp view given by it of easier objects, tested it upon the last diatom of the Test Plate, using a Hartnack objective No. 10, and resolved the "test" at first trial.

THE STUDY OF LICHENS.—The explanation of the peculiar double nature of the lichens has lately become the subject of much discussion. It has been long recognized that in the tissue of lichens, are to be found two quite distinct classes of elements. By one class the lichens are allied with the fungi, by the other with the algæ. The great body of a lichen is made up of a structure exactly identical with certain fungi, while scattered through the

substance are green granules or cells called gonidia; these bear a strong resemblance to certain kinds of algæ.

The same double nature of the lichens is evinced in their fructification, even more strikingly than in the simple vegetative system. The complete identity of fruit (apothecia and spermagona) produced by hyphen threads of lichens with fruit of the division Ascomycetæ of the fungi has been well known, and has even led to the classification of this division of fungi with the lichens (by Schleiden in 1842). But what astonishment was created when, in 1867, Famentzin and Baranetzky showed that the gonidia also, in favorable circumstances, produced fruit identical with the zoospores of algæ.

The question presses home more and more, whether the lichen is a single individual whose development follows these two divergent paths, or whether two distinct individuals out of different natural classes have combined together to live a united life.

On the former supposition, the complete agreement of the gonidia of lichens with certain algæ, and the fact that gonidia freed from the lichen threads in which they lie embedded possess the power of independent life and development (in which state they cannot be distinguished from algæ): these two considerations have led to the almost inevitable conclusion that numerous genera of algæ (as supposed) are undeveloped or, it may be, abnormal states of lichens. Famentzin and Baranetzky have lately adopted this theory. On the other hand, De Bary (1866) has pointed out the possibility that in the case of the "jelly-lichens" (Gallertflechten) the gonidia may be real algæ which have assumed the form of lichens because parasitic fungi (of the family Ascomycetæ) have united themselves with them.

Since 1867 Schwendener has extended this theory over the whole class of lichens. According to him lichens consist of algæ spun over, and swallowed up, as it were, in the meshes of the mycelia of certain fungi. There seemed one thing only needed to establish this theory, namely, to succeed in raising lichens by sowing the spores of fungi on gonidian-like algæ. This experiment has been successfully carried through in the case of a given species of the genus *Collema*, by Dr. Beess in 1871.

Although this would seem to close the case, yet the new view is not accepted by the most experienced lichenologists. They hold the view of the single nature of the lichen, saying that the

resemblance of gonidia to algæ does not prove identity, that they have microscopically demonstrated the genetic connection of the gonidia with the hyphen threads of that lichen, and that Tulasne has raised lichens from lichen spores, without the presence of any algæ; hence the Berlin Academy has announced the following Prize-question: "The proving of Schwendener's view of the double nature of the lichen," by means of original investigations. And they recommend the study of the following points.

1st. An exact study of the numerous one-celled forms of algæ which so closely resemble the gonidia of lichens. These are now classed in the genera *Pleurococcus*, *Cystococcus*, *Glococystis*, etc.

2nd. Continuous investigation on the gonidia contained in the thallus of lichens, especially with regard to their development after being freed from the lichen thallus for the purpose of ascertaining with more certainty the different types of algæ that appear. The question whether among the great number of green gonidia, inhabiting lichens, there may not be more numerous types than has been supposed, taken in connection with the investigations suggested above on the free living forms of algæ ought be kept clearly in mind. The case of the occurrence of different forms of gonidia in one and the same lichen deserves special attention.

3d. The carrying on of repeated "culture-from-spore" experiments with lichens from different families with and without the presence of the algæ that are supposed to be the nourishing plants. This should be especially done with lichens containing chlorophyl-green gonidia.

The work may be presented in German, Latin, French, English or Italian. Important points of investigation must be illustrated by drawings, and the presentation of preparations (microscopic) is advisable.

The time for sending in the papers is fixed at the first of March, 1875. Real names are to be sent in sealed envelopes. The prize is one hundred ducats.— T. D. B.

Misnaming Objectives.—[Mr. Wenham has made public the following brief reply to Mr. Stodder's communication on this subject in the August number of the Naturalist. This controversy, having already called sufficient attention to the points at issue, would be fruitless if still further prolonged.] I should

not have taken time to notice the long comment on my short letter, appearing on page 234 of the "Monthly Microscopical Journal" for May, 1872, but for the remark that my letter was written with "evident loss of temper!" Quite the reverse; it was penned in a spirit of "chaff," and Mr. Bicknell, in his brief note in reply, seems to have caught the vein; at which no one, perhaps, laughed more heartily than myself. On the other hand, it has drawn C. S. out of his shell, with horns erect, in his proper name or color. I have nothing further to say on the question, which leads to no scientific discovery, and is one to be settled between the makers of object-glasses and purchasers, who are now sufficiently warned. No particular reform can be anticipated by pages of controversy having for its very basis such full scope for personalities, of which this and the above may be taken as a sample. The tone is becoming silly and tiresome; and having contributed my share, I must drop the subject with the remark that no one would be more willing to induce the makers to adopt a nomenclature having a definite reference to actual magnifying power than myself, could I see the possibility of doing so. Numerals such as those adopted by the Continental makers would perhaps partly meet the difficulty; but I believe that no English optician would consent to name his glasses this way.—F. H. WENHAM.

NEW YORK UNCINULÆ.—Mr. Charles H. Peck has communicated to the Albany Institute a synopsis of the New York (State) Uncinulæ, described seven species as occurring in the state in addition to two described by Dr. E. C. Howe. Only three species are credited to Great Britain, whose mycology has been well investigated. Our species are systematized as follows.

Appendages to the conceptacles thirty or more.

Sporangia with eight spores,.................... *U. circinata.*
Sporangia with six spores...................... *U. parvula.*
Sporangia with four spores,..................... *U. adunca.*
Sporangia with two spores,...................... *U. macrospora.*

Appendages less than thirty.

Appendages white, flexuous toward the tips,... *U. flexuosa.*
Appendages white, not flexuous,................ *U. Clintonii.*
Appendages colored,............................ *U. ampelopsidis.*

Dr. Howe's species are *U. Americana* (*U. spiralis* B. & C.) figured but not described by Berkeley, which is near *U. ampelopsidis* but has appendages few, longer and colored; and *U. luculenta* which is

much like *adunca*, but has fewer and longer appendages and sometimes sporangia with five or six spores.

STAINING VEGETABLE TISSUES. — L. Erckmann explains, in the "Journal of the Franklin Institute," that the staining of plant sections with a weak solution of aniline red, and then washing out with water the color from all the non-nitrogenous parts, is not only useful for purposes of general study, but is especially applicable in the preparation of specimens for photographic use.

NOTES.

A semiannual session of the National Academy of Science was held at Cambridge, November 21st, 22d, 23d, in the lecture room of the Museum of Comparative Zoology, where Professor Agassiz welcomed the members, and gave an account of the rise and present condition of the museum. Of the twenty-eight papers read there were presented thirteen relating to geology and zoology, with the following titles:—

The Organization of the Museum of Comp. Zoology in Cambridge, by L. AGASSIZ.

On three different Modes of Teething among Selachians, by L. AGASSIZ.

The Development of Actiniæ, by ALEX. AGASSIZ.

The glacial Phenomena of the southern Hemisphere compared with those of the North, by L. AGASSIZ.

Affinities of Echinoderms and Worms, by A. AGASSIZ.

Notice of Investigations making in California on the Reliability of the Barometer as a hypsometric Instrument, by J. D. WHITNEY.

Pedicellariæ of Echinoderms, by A. AGASSIZ.

Results of recent Dredgings on the coast of New England, by A. E. VERRILL.

Embryological Fragments concerning the Volutidæ, by L. AGASSIZ.

On the specific Identity of some Animals along the Atlantic and Pacific shores of America, by L. AGASSIZ.

The copulatory Organs of the Selachians compared with one another, and with those of other Vertebrates, by L. AGASSIZ.

On the changes Selachians undergo with age, by L. AGASSIZ.

Critical remarks about scientific views entertained upon theoretical grounds, by L. AGASSIZ.

Notice of the progress of the topographical work of the Geological Survey of California, by J. D. WHITNEY.

Professor Agassiz read a paper on "Three Different Modes of Teething among Selachians." He said that in former years he had paid considerable attention to the peculiarities of teeth among the Selachians, but the progress of zoology and palæontology made the present materials on hand quite insufficient. It was not known what changes took place with age. So he had determined upon

the voyage of the Hassler to make the collection of Selachians a principal object. He had been richly rewarded for his efforts. Since his return he had made careful examination of the collection, comprising sometimes two hundred specimens of one species. The result of this examination was that while in their adult condition the Selachians present characters which are very constant among specimens of the same age, there are such changes among them that even genera have been founded on the difference of age. Professor Agassiz then illustrated from abundant specimens and upon the blackboard the variations of dentition in Selachians of different ages from the embryo to the adult. In concluding he alluded to the relation which the facts of variation he had presented might falsely be supposed to sustain to the development theory. The conditions which occupied a certain place in the series to be derived one from another should be consecutive in time. This was not the case. It was the endless series of anachronisms which were being made by the supporters of the transmutation doctrine which had kept him aloof from all such interpretations of Nature. When it should appear that these different features fall in time as they may appear to fall in their connection by similarity, then there would be some ground for the inference of a gradual change. Geologists ought to be as careful in their generalization as were physicists. He thought that there was too much loose twaddle and argument and debating-club demonstration in our Natural History. He had been told recently by one who occupies a very high position in science that "unless you deduce one being from another you are not following a legitimate scientific course." It should first be proved geologically that there is such a genealogical connection. The facts show, indeed, something that should not be overlooked, viz.: that there is thought in nature, and until it is proved that thoughts are derived one from another, he would not admit that the similarity of two objects proves their derivation one from the other.

Mr. Alexander Agassiz made a communication on the "Development of the Actiniæ."

The second day's session opened with an account of the glacial phenomena of the southern hemisphere compared with those of the north, by Prof. Agassiz. Any one who had been familiar with the glacial phenomena as exhibited in the northern hemisphere, both in Europe and the United States, and who would have ac-

cepted, even with considerable limitation the general conclusions he had presented concerning the glacial period, might have foretold, said Prof. Agassiz, that the southern hemisphere would present the counterpart of all these phenomena. And yet he supposed that many of his friends thought he was over-sanguine when, in a letter to the Superintendent of the Coast Survey, he had told what he expected to find, in this matter, during the Hassler Expedition. The hesitation which was prevalent concerning these generalizations arose from the view which many entertained of the true cause of the phenomena. Many thought that the greater extension of glaciers in the Alps and most parts of Europe was to be ascribed to the former existence of large sheets of water in the north of Africa, from the evaporation of which great amounts of snowy deposition could be formed upon the Alps, and thus enlarge the glaciers. But he would ask those who entertained this view how a sheet of water in Africa could have made great sheets of ice upon the continent of North America? There had been a disposition more or less outspoken among geologists to view the phenomena of the greater extension of glaciers in a former period as the result of local glaciers. He believed he was the only one among investigators of that subject who had urged a distinction between local glacial phenomena and the general glaciation of our continents. It was because he was familiar with the distinction between these two sets of facts that he had always held, from the very beginning of his investigations, that there was a time when our earth presented climatic conditions so totally different from those now obtaining, that the northern hemisphere was covered by an extensive sheet of ice, and that the phenomena to be ascribed to the agency of that sea of ice moving from north southward were those uniform glacial appearances which we find over continental expanses, and traces of which we find even in high elevations. He had been convinced that whoever should explore the southern hemisphere on an extensive scale would find the evidence from extensive glaciation on the southern hemisphere as well as on the northern, but that the trend of the southern ice sheet and the transportation of bowlders would be reversed. Instead of moving from the north southward as in the northern hemisphere, the movement should be from the south northward, and the accumulations of loose materials in southern moraines should present an arch curving northward. He could say that he had seen in the southern hemi-

sphere all that he had expected to find. The occurrence of these phenomena on a large scale in the southern hemisphere tended at once to establish the fact that the glacial phenomena were cosmic phenomena, and were not owing to local geological occurrences. He contended that the ability to recognize glacial phenomena depended in a great measure upon thorough familiarity with it, there were so many elements to be taken into account. Yet the track of the glacier could be detected as certainly as the hunter detects the track of his game. Causes of deception in interpreting the glacial phenomena were pointed out in detail. He showed the distinction between local glacial phenomena and phenomena belonging to general glaciation. The evidence obtained from erratic bowlders was examined and apparent contradictions explained. In some of the New England regions he had traced the tracks of bowlders for seventy miles in unbroken continuity. In the southern hemisphere he had traced them over a much longer distance.

He would make a statement which he expected would not be accepted for many years; it was that all our mountains below eleven thousand feet had all been scored over by the great sea of ice; that the whole range of the Rocky Mountains had been under ice, with only a few prominent peaks, perhaps rising above the fields of ice. He thought that the great ice sheet could not have been less than ten or twelve thousand feet thick and might have been thicker. In the Andes he had become acquainted with signs of glacial action twelve thousand feet above the sea.

Prof. J. D. Whitney, State Geologist of California, read a paper on "Notice of Investigations making in California on the reliability of the barometer as a hypsometric instrument." His remarks were illustrated by charts and tables.

Prof. Agassiz and Prof. Hilgard followed in remarks commending the geological survey of California as a work of great national importance, and hoping that the Academy would use its influence to prevent its interruption.

Prof. A. E. Verrill gave an interesting account of results of dredging on the coast of New England in connection with the United States Fish Commission. The explorations had added at least three hundred and fifty species to the fauna. Among the polypes prior to this investigation there were known but twelve species. They had added seven species. They had added thirty-eight species to the forty-eight Acalephs; ten species to the Echin-

oderms; ninety-five to the mollusks, one hundred and twenty-five to the worms and ninety to the crustacea. Additions to the Echinoderms and others were mentioned.

The second day's session was concluded by remarks by Prof. Agassiz about "Scientific Views entertained upon Theoretical Grounds." Prof. Agassiz' remarks were a protest against hastily adopting scientific theories unsupported by sufficient matter-of-fact evidence. He felt more and more the danger of stretching inferences from a few observations. The manner in which the evolution theory in zoology is treated would lead those who are not zoologists to suppose that observations have been made by which it can be inferred that there is in nature such a thing as a gradual change among organized beings, and that the transformation has actually been traced. But there is no such record, and it is shifting the grounds from one field of observation to another to make such statements. When the assertions go so far as to exclude from the domain of science those who will not be dragged into the mire, he thought it time to protest.

On the concluding day of the session Mr. Alex. Agassiz spoke on the Affinities of Echinoderms and Worms, and Prof. Agassiz on the Reproductive Organs of the Selachians compared with one another and with those of the Vertebrates.

At a meeting of the Indianapolis Academy of Science, Prof. E. T. Cox exhibited a meteorite about four pounds in weight, found by Dr. Seville, in 1870, in the plastic clay under a bed of peat in Howard County, Indiana, about seven miles east of Kokomo.

Mr. G. R. Crotch is engaged in preparing a checklist of the Coleoptera of North America to facilitate exchanges and records of faunas. It will make a pamphlet of about 70 pages, to cost 50 cents, and will be published by the Naturalists' Agency. Subscriptions are requested that the size of the edition may be at once determined on.

George Catlin the well known Indian painter and student of Indian character and customs, died at Jersey City, on December 23d, in the seventy-sixth year of his age.

A reprint of the late Dr. Clemens' papers "On the Tineina of North America," with notes by the editor, H. T. Stainton, Esq., has just been published by Van Voorst, London.

Mr. Edward Whymper has arrived at Copenhagen from his second exploration of W. Greenland. He brings with him rich collections of curiosities, and some singular specimens of fossil wood.

Professor Agassiz has recently been elected a foreign associate of the French Institute (Academy of Sciences). It may be remembered that the number of foreign associates of the Academy of Sciences is limited to eight.

We are glad to learn that Mr. Charles Stodder has saved from the conflagration of November 9th, all his valuable stock of Tolles's telescopes, microscopes, and microscopic objectives. Work in the shop will go on, and all orders filled as usual.

ANSWERS TO CORRESPONDENTS.

J. M., Penn.—The glass paraboloid, "Wenham's Parabola," has been prominently brought forward as a means of transparent illumination with high powers, by Chevalier Huyttens de Cerbecq, of Brussels. As thus used it gives excellent definition with a well corrected lens, but fails completely with a poorly corrected one.—R. H. W.

R. M. D., New York.—It would probably be undesirable to have all objectives mounted in brasswork of exactly the same length measured from the focal point of the objective to the top of the mounting. The convenience attained in working with the straight form of a double-nose piece would not compensate for the disadvantage of wearing the rack almost entirely at one point. A general uniformity of length of compound body, however, is greatly to be desired.—R. H. W.

W. W. R., Indiana.—1. The best microscopical definition attainable at present is by means of "immersion" lenses. 2. They are practically as durable as dry lenses, since both will last, with frequent but careful use, until rendered obsolete by the improvements constantly being made in their manufacture. 3. They are not more liable than other objectives to injury by changes of temperature, etc. 4. Several first-class makers have been accustomed for many years to furnish immersion objectives which can be instantly transferred, by screw-collar adjustment, to dry objectives. Thus the owner has a choice of style, with no compensating disadvantage.—R. H. W.

BOOKS RECEIVED.

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Bericht ueber die Thatigkeit der St. Gallischen naturwissensch. Gessellschaft. 1870-71. 8vo. 1872.

Proceedings of the Royal Society of Edinburgh. 1870-71. 8vo.

Annales Academici, 1867-68. Leyden, 1872. 4to.

Sitzungsberichte der K. Akadamie der Wissenschaften. Math. Naturw. Classe. Bd. lxiv. Abth. 1. Heft i-v. Abth. 2. Heft i-v. 8vo. Wien. 1871.

Denkschriften der K. Akademie der Wissenschaften. Math. Naturw. Classe. Bd. 31. Wien, 1872. 4to.

Sitzungsberichte der Naturwissensch. Gesellschaft Isis in Dresden. Jahrg. 1872. Jan.-March. Dresden, 1872. 8vo.

Memoires de la Societe Royale des Antiquaires du Nord. 1866-71. Copenhagen. 8vo.

Transactions of the Literary and Historical Society of Quebec. 1871, 1872, Quebec. 8vo.

Proceedings of the Boston Society of Natural History. Vol. 14, pages 225 to end. 8vo. 1872.

Memoirs of the Boston Society of Natural History. Vol. 2, part 2, No. 3; part 2, No. 1; and Part 2, No. 2. 4to. 1872.

Proceedings of the Academy of Natural Sciences of Philadelphia. Part 2. May and Sept., 1872. 8vo.

A New Theory of the Origin of Species. By B. G. Ferris. 12mo, pp. 69. New Haven, Chatfield and Co. 1872.

On the Fossil Red Hematite Ore of Bedford Co., Penn. By J. P. Kimball. 8vo, pp. 22. 1872.

On the Silver Mines of Cusihuiriachic, Mexico. By J. P. Kimball. 8vo, pp. 11 and map. 1872.

Report on the Fairchauer Iron Company Estab. By J. P. Kimball. 8vo, pp. 28. 1872.

Le Naturaliste Canadien. Quebec. Dec. 1872. *Petites Nouvelle Entomologiques.* Paris. No. 64. Dec., 172.

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COLORS OF VEGETATION.*

BY PROF. D. S. JORDAN.

THE coloration of plants is due to the presence in the cells of minute globules, which are usually green in the herbaceous parts, the leaves, sepals, etc., and of various hues in the flowers and fruits.

The normal color of foliage is green, but it may be of almost every conceivable shade and degree of intensity. It may be of a yellowish-green as in the parsnip, or of a blue-green as in the sweet pea. It may be pale and shining as in the orchis, or dark and shining as in the laurel. It may be intense and vivid as in the young leaves of the horse-chestnut, or of a neutral Portage sandstone color as in the Cassandra or leather leaf.

The causes of these differences are partly chemical and partly physical: the chemical causes producing the different shades of color, the physical the differences in brightness and intensity.

First, as to the chemical differences. The French chemist Frémy finds that chlorophyl or leaf green is composed of two distinct substances: the one of a bright blue color which he calls *phyllocyanin;* the one of a yellow color known as *phylloxanthin.* The unequal proportions of these two ingredients which are simply mixed in the leaf cells would account for the absolute differences in color. Thus in the bluish-green leaves of the pea

* Read before the Cornell University Natural History Society.

family the blue substance should be found to predominate, and in the yellowish-green leaves of the hickories the yellow substance should be in the ascendant. Indeed it has been found that, in the outer leaves of the cabbage, the phyllocyanin or blue substance exists in much greater proportion than in the inner leaves which have been deprived of sunlight.

Now as to the physical causes producing differences of intensity. In the dark shining leaves such as those of the laurel, prince's pine, partridge berry, etc., the depth of color is due to the closeness with which the cells are packed together. Each cell contains a globule of chlorophyl, and it is evident that, other things being equal, the smaller the cells and the more compact their arrangement, the darker will be the color of the leaf.

And as to the differences in vividness of color. In the young leaves of the horse-chestnut, the cuticle is very thin and the cellular substance of the leaf is very transparent; hence the green of the globules of chlorophyl shows brightly through. On the contrary, in the Cassandra or leather leaf, the cellular tissue is of a thick husk-like texture and the leaves are of necessity dull colored. The blue coloring substance in leaves is much less stable than the yellow. It rapidly decomposes or is transformed in the absence of sunlight. You have all noticed what a yellow hue the foliage of trees wears in wet and cloudy springs, and even in summer, a week or two of sunless weather will often make a perceptible difference in the color of the woods. Always the lower and inmost leaves of a tree are paler than the rest and of a yellowish hue, like the complexion of boys "brought up in the house." Cold weather bleaches chlorophyl and vegetable coloring matters generally. The further north we go the more liable do we find plants to albinism or loss of color. Flowers of Arctic or mountainous regions are always paler and more delicate in hue than those of warm countries and they are far more subject to white varieties. Linnæus says that "there is not a single blue or red flower in Lapland that has not its white varieties." The yellow coloring matter is much less easily affected by absence of light and other causes and yellow flowers rarely exhibit any striking variations in hue. Many plants are entirely destitute of chlorophyl. These are parasites, and as they depend for their nutrition on the sap already elaborated by the supporting plant they have no need of chlorophyl. The cells may be filled with orange-purple

or tawny coloring substances or they may be empty, leaving a white plant, like the Monotropa and mushroom. Lichens and fungi growing on living or decaying organisms have also no need of chlorophyl; hence in the economy of nature they are unprovided with it. They often exhibit bright tints due to the presence of various coloring matters whose character is not well understood. Recent experimenters have succeeded in isolating some forty different coloring substances in a species of mushroom. Some fungi are luminous like the glow-worm. I do not know the theory of this. That peculiar luminosity of rotten wood, often supposed to be "phosphorescence" and known by woodsmen as "fox fire," is due to the presence of a species of fungus.

Much has been written about autumn coloration, but the subject has been treated from an æsthetic rather than from a scientific standpoint. We are more interested in "the rosy cheek than we are to know what particular diet the maiden fed on." However, in a general way, we say that the bright colors of leaves in the fall are caused by the oxidation of the chlorophyl. This is really a process of ripening. A brilliant autumn leaf is not dead but mature. "Flowers are but colored leaves, fruits are but ripe ones. The edible part of most fruits is the parenchyma or fleshy tissue of the leaf of which they are composed." The ripening of a maple leaf and a red astrachan apple is precisely the same process. In both cases it is an absorption of oxygen and a change of the blue substance of the chlorophyl to red. The yellow substance is not easily acted upon, hence the prevailing color of autumn foliage is scarlet, which is a mixture of yellow and red.

M. Chàtin has a different theory as to the production of scarlet leaves. He claims that the entire mass of chlorophyl is oxidized first to yellow and then to red, and that red leaves contain yellow chlorophyl in the inner cells which has not yet been oxidized. He thinks that yellow leaves in autumn are those in which the process has been arrested at the yellow stage before they arrive at redness. But the leaves of the oaks become crimson without passing through any intermediate stages of yellow or scarlet. This theory also appears improbable in the case of the hickory, aspen, etc., whose bright yellow autumn foliage shows no tinge of red. Besides such a change as he imagines would be inconsistent with the theory of the compound nature of chlorophyl.

It seems to be pretty well established by the experiments of

M. Cloez and others on the different varieties of hyacinth and bachelor's button (Centaurea cyanus), that oxygenation or acidification changes vegetable blues to red, and that the two colors are chemically identical and chemically distinct from the yellow. In ordinary leaves, we find the blue and yellow substances nearly in equilibrium, but in the colored parts of the flower, one or the other predominates. Thus flowers are naturally divided by their colors into two great classes, according to whether the cyanic or xanthic principle is in the ascendant.

Desvaux, one of the most painstaking of observers, has studied for ten years the gradations of color in the twelve hundred varieties which have been produced of the kidney bean. He divides the colors of flowers into two series.

1st. The cyanic series, those having blue for their type and capable of varying to red or white, but never to yellow.

2d. The xanthic series, those having yellow for their type and capable of varying to orange or white, never to blue. Both series commence in green, which is blue and yellow, and end in white which is the absence of all color.

Thus the tulip was originally yellow. All of its varieties belong to the xanthic series. So with the dahlia and zinnia. There never was a blue tulip, primrose or dahlia. The geraniums, phloxes, verbenas, etc., vary throughout the cyanic series, and a yellow geranium or phlox is unknown.

Different species of the same genus sometimes belong to different series, as is the case with the roses and violets. Rarely different parts of the same flower belong to different series as in the convolvuli and forget-me-nots. Though the rules of color are liable to many exceptions, yet it seems to me that Linnæus' great maxim "Nimium ne crede colori," "Put not your trust in colors," is too absolute. For example, the hue of a single petal of Solanaceæ stamps at once the order.

"The science of Vegetable Chromatology," observes M. Guérin, "is yet in its infancy; and it is impossible to establish any rules to which there are not many exceptions."

All theories yet advanced, however ingenious they may be, are liable to objections of such great weight that none can be admitted as absolutely true. For example, let us take the theory of Macquart, that "color results from the decomposition of carbonic acid and the disengagement of oxygen, and that its intensity is propor-

tional to the amount of luminous fluid—light, which is present." This decomposition can take place only in the presence of sunlight and chlorophyl, but there are many parts of plants in which chlorophyl is entirely wanting and which develop in the absence of light, yet which nevertheless are brightly colored. Roots and tubers are often of brilliant hues, as in the carrot and gold-thread. So also the inner wood of a tree, as in the magnolia and rosewood. These colors are formed in the presence neither of sunlight nor chlorophyl, so there must exist other causes of coloration than that allowed in the theory of Macquart.

Again, although submarine vegetation is usually of a dull green or brown, we find many seaweeds which are brilliantly tinted, although they receive but a very feeble light. Although chemical analysis throws some light on the laws of vegetable chromatology, yet the color of the flowers cannot in general be taken as any index of the medical properties of plants, for we may find the same colors at once in the most poisonous herbs, as fox glove and belladonna, and in the most innocent, as the primroses and violets.

The flowers of many plants are subject to changes in color. The closed gentian, for example, changes from a deep indigo-blue to a reddish-purple. The white Trillium becomes of a delicate rose color just before it withers. The ray flowers of Xeranthemum are straw color when they first expand becoming, at last, of a bright crimson. A more striking example is the *Gladiolus versicolor* which is brown when it opens in the morning, changes to a clear blue in the noonday sunshine and returns to brown again at night to go through the same variations the next day.

Black as a color exists in vegetation only in the roots, seeds and a few fruits. It does not occur in the flowers. All the approaches to it, as in the case of the dark spot on the corolla of the coffee bean, are simply an intense violet. There are no flowers of a pure white. The famous flower painter Redouté, observed long ago that in flowers which appeared white, there is always a faint tinge of rose color, yellow or blue. When a white petal is viewed by transmitted light we see various shades produced by some coloring matter present in the cells in a state of extreme dilution. White frequently with a tinge of pink is the most common color in spring flowers and in flowers of Arctic regions. Red is the hue of summer flowers and of acid fruits; bright red is rarely

seen in early spring flowers and in the autumn it also disappears. But in June and July, the flowering time of the roses, laurels and azaleas, it is one of the most abundant colors. Yellow is more properly an autumnal color, and it often characterizes large groups, as the golden rods, sunflowers and buttercups. Blue is a summer color, but it runs throughout the year from the hepaticas of the hue of the March sky above them, to the fringed gentians and asters of the November woods.

Numerically, yellow flowers are far the most abundant: next comes white, then red and blue. Red is very often the hue of the stems of plants especially in late summer and autumn. This is common among the grasses, some of which brighten into a purple mist as intense in color when seen at a little distance, as the most brilliant patches of laurel or meadow beauty.

"In most plants," says Thoreau, "the corolla or calyx is the part which attains the highest color and is the most attractive; in many it is the seed vessel or fruit, in others still it is the very culm itself which is the blooming part."

In conclusion we come to the question, what is the use of the colors of vegetation? In a strictly utilitarian point of view they seem unimportant. There are some plants, chiefly orchids, which require the aid of insects to secure fertilization and which attract them by their bright colors, but these plants are very few and most flowers could accomplish their destined purpose just as well were they clad in the drab of the veriest Quaker.

The flowering time is the nuptial season, the honeymoon of the plant, and it is the nature of flower and beast, of bird and man to "spruce up," to put on his brightest colors at pairing time.

The science of Vegetable Chromatology is one in which much is seen and little is known. We can all see with our own eyes that plants are variously colored: that even Solomon in all his glory was not arrayed like one of our meadow lilies; but when we get beyond our eyes and ask why this is so, we find ourselves at a loss; we cannot answer. We only know that the Lord doeth as pleaseth Him with the flowers in his garden.

ON THE LIMITS OF THE CLASS OF FISHES.

BY THEODORE GILL, M.D., PH.D.

In the classification of the animal kingdom the vague ideas prevalent among the vulgar and originating in prejudices based on habitat or external appearance have been more or less reflected, and special forms associated with earth, air and water. Thus were the inhabitants of the "element" associated together on the one hand, and separated from those of other "elements" in the other by the ancient cosmologists and poets.* This was the first generalization or attempt to combine the groups which from all time have been recognized as "beasts" or "animals," "birds," "fishes," and others in still more comprehensive groups. But, in time, and as investigation was directed to the structure of animals, it was found that the preconceived ideas respecting the relations of the various forms to the media which they inhabited, were by no means the correct expressions of the relations of such forms in structural features. The recognition of this fact resulted in the admission of several classes (anticipating the definite ideas which are now associated with such groups) and the virtual separation of the vertebrates from the invertebrates. But the ancient

* In the beginning God created the *heaven* and the *earth*. And the earth was without form and void.

And God made the firmament, and divided the *waters* that were *under* the firmament, from the *waters* that were *above* the firmament: and it was so. And God said: Let the waters under the heaven be gathered together unto one place, and let the *dry land* appear: and it was so.

And God said: Let the *waters* bring forth abundantly the *moving creature* that hath life, and *fowl* that may fly above the earth, in the *open firmament* of heaven.

And God said: Let the *earth* bring forth the *living creature* after his kind, cattle and creeping thing, and beast of the earth after his kind: and it was so.— *Genesis, Ch. I, verses* 1, 2, 7, 9, 20, 24.

The same idea is expressed by several of the ancient poets and especially by Ovid in the following lines:—

Ante mare et tellus, et, quod tegit omnia, cœlum,
Unus erat toto naturæ vultus in orbe,
Quem dixere Chaos; rudis indigestaque moles;

. . . .

Hanc Deus et melior litem natura diremit:
Nam *cœlo terras*, et terris abscidit *undas*;

. . . .

Neu regio foret ulla suis animantibus orba;
Astra tenent *cœleste* solum, formæque deorum;
Cesserunt nitidis habitandæ *piscibus undæ*;
Terra feras cepit; *volucres* agitabilis *aër*.

— *Ovid, Met. I, l.* 5–7, 21–22, 72–75.

idea of a certain relation between form and habitat still prevailed to a greater or less extent, and the vertebrates, in the earliest days of systematic zoology, were instinctively divided into quadrupeds, or animals especially fitted for progression on land; birds, especially adapted for flight and fishes, destined for life in the waters; while those animals not referable to either category, such as reptiles, bats, etc., were slurred over or forced into combination with the others on account of some points of real or supposed agreement. Soon, however, the distinction of the cold-blooded quadrupeds from the warm-blooded ones (mammals) and the affinity of the former and the serpents were recognized, and the class of "reptiles" constituted. It was long before it was fully and generally acknowledged that the latter was a heterogeneous assemblage of forms having very diverse relations, part of them being closely related to birds, and the others almost undistinguishable from fishes. Such recognition has now become practically universal, but, at this point, the progress of zoological taxonomy as exhibited in the appreciation of the subordination of types has been to a great extent arrested, and naturalists have mostly been content to recognize the five classes, Mammals, Birds, Reptiles, Batrachians, and Fishes. Several naturalists, however, have dissented from this view, and indeed the class of fishes has not been so universally recognized with the limits the mind is still most apt to connect with it as is usually supposed.

The Class and its modifications.—The cetaceans and fishes were regarded as a group coördinate with the warm-blooded quadrupeds (mammals) and birds, either avowedly or by implication, till Brisson, in 1760, finally withdrew the former from the class, and placed them in more immediate relation with the warm-blooded quadrupeds, regarding them, however, as constituting a peculiar class: the class of fishes, thus relieved, was for the first time presented with the limits since generally recognized.

It is true that, as a matter of fact, the agreement of the cetaceans with the mammals in their respiratory apparatus and warm blood had been long previously recognized, even by Aristotle and indeed by every observer capable of comparison of facts, but in spite of such recognition, the apparent agreement in form and adaptability for progression in the waters exercised such a preponderant influence over the mind, that the hints thus offered were not accepted in their fulness till 1758 by Linné.

Linné first, in the tenth edition of his "Systema Naturæ" (1758), eliminated the cetaceans from the class of fishes and combined them with the viviparous quadrupeds in a single class, for which he proposed the now universally accepted name Mammalia. At the same time that he eliminated the cetaceans, however, he violently divorced from the class of fishes and referred to the amphibia, under the name Amphibia nantes, first (in 1758), all the Chondropterygii of Artedi (except the sturgeons) as well as the genus Lophius; and, subsequently (1766), he removed still others from the class, completing the removal of the Chondropterygii by the exclusion of the sturgeons, and discharging at the same time the genera Cyclopterus, Balistes, Ostracion, Tetrodon, Diodon, Centriscus, Syngnathus and Pegasus, most of which formed the Branchiostegi of Artedi. He seems to have been led to this measure by the belief that they were provided with lungs instead of gills, apparently having been misled by an erroneous observation of Dr. Garden, of Charleston, on Tetrodon.

Gmelin, in his edition of the "Systema Naturæ" (1788), restored to the class the forms thus divorced from the fishes.

The genus Myxine was referred to the class Vermes by Linné and his followers, and therefore doubtless was overlooked by Bloch, who redescribed it as a fish under the name Gastrobranchus.

The constituents of the class having been at length, for the time, agreed upon, the question of its subdivision or union with others was next agitated.

Pallas combined the fishes with the Amphibia of Linné in a class, coördinate with mammals and birds, which he named Monocardia. Long afterwards, Prof. Owen adopted the same view, but gave the new name Hæmatocrya.

On the other hand, the elder Geoffroy St.-Hilaire, and following him, Latreille,* separated the combined Elasmobranchiates and Marsipobranchiates as a class (equivalent to the order Spiraculata of Pallas), and named it Ichthyoderes or Ichthyodera. This view, however, fell still-born.

In 1856, Prince Charles Bonaparte † recalled that Isidore Geof-

* LATREILLE (Pierre André)—Familles Naturelles du Règne Animal, exposées succinctement et dans un ordre analytique avec l'indication de leurs genres. Paris, J. B. Baillière. Libraire de Bandouin Frères. 1825. [8vo, 570 pp.]—Troisième Classe, Ichthyodères, Ichthyodera (G. St. H.), p. 107; Quatrième Classe, Poissons, Pisces. p. 112.

† Bonaparte (Prince Charles Lucien) Additions et corrections aux Tableaux parallèliques de la deuxième sous-classe des Oiseaux, Præcoces ou Autophages; . . .

froy St.-Hilaire * had, in 1852, separated from the class of fishes as the type of a new class (Myelozoa) the genus Branchiostoma or Amphioxus (a species which was originally described by Pallas as a member of the molluscan genus Limax), rediscovered and first referred to the class of fishes by Costa in 1834. Bonaparte, at the same time, proposed to withdraw from the invertebrates the genus Sagitta (Quoy and Gaimard) and elevate it to the rank of a class (Aphanozoa) of the vertebrates.†

In the elevation of Sagitta to the rank of a class Bonaparte has anticipated Professors Carus and Huxley (who also elevated the same form to class rank, retaining the name Chætognatha, originally conferred upon it as the type of an *order* by Leuckart). But his views respecting its pertinence to the branch of vertebrates are untenable, for there can now be no doubt that it is at least most nearly related to the class of annelides.

In 1857, the question of the primary classification of fishes was again reviewed by Prof. Agassiz. That eminent zoologist "was satisfied that the differences which exist between the Selachians (the skates, sharks, and Chimæræ) are of the same kind as those which distinguish the amphibians from the reptiles proper and justify, therefore, their separation, as a class, from the fishes proper. I consider also (he adds) the Cyclostomes as a distinct class for similar reasons; but I am still doubtful whether the Ganoids should be separated also from the ordinary fishes." He finally however admitted four classes, viz :—

"1st class; Myzontes with two orders, Myxinoids and Cyclostomes.

(Suite et fin.) <Comptes rendus hebdomadaires des séances de l'Académie des Sciences, (1er Dec. 1856) XLIII, 1017-1027.

* I have been unable to find any memoir or paragraph in any work by Geoffroy St.-Hilaire embodying the view referred to, and suspect it may have been a verbal communication, and never actually published.

† Que le Sagitta, Quoy et Gaimard, cet animal singulier si commun dans les mers du Nord, découvert par nos intrépides voyageurs, et ballotté par les savants entre les Mollusques, les Vers et jusqu' aux Acalèphes! possède dans la première période de sa vie une grosse corde dorsale qui en fait un Vertébré subissant une métamorphose rétrograde dans le sens de Rathke. C'est à M. Meissner, jeune professeur à Bâle, qu'on doit cette belle découverte. Cet animal, qui dans l'état actuel de la science ne pourrait être regardé que comme un Poisson, pour ainsi dire, dégradé, mériterait de former une classe à part, bien plus encore que l'Amphyoxus ou Branchiostoma, dont notre savant Président a fait le type de sa classe des *Myélaires* (Myelozoa). depuis 1852. En effet, la corde dorsale (qui forme le distinctif essentiel des Vertébrés) s'oblitérant et disparaissant complétement dans l'adulte, constitue un caractère tellement important, qu'il ne peut désigner un groupe d'un rang moins élevé que celui de classe; il pourrait être convenable de donner à cette classe le nom *d'Aphaniaires* ou Aphanozoa. *Op. cit.* p. 1022.

2d class; Fishes proper with two orders, Ctenoids and Cycloids.

3d class; Ganoids with three orders, Cœlacanths, Acipenseroids, and Sauroids; and, doubtful, the Siluroids, Plectognaths and Lophobranches.

4th class; Selachians with their orders, Chimæræ, Galeodes, and Batides."*

The Leptocardians and Dipnoans were not referred to in this essay and consequently it is doubtful what the author considered to be their relations.

In 1866, Prof. Häckel also divided the fishes into four classes, but on entirely different grounds and with extremely different limits from those proposed by Prof. Agassiz; the classes recognized by Häckel being represented severally by (1)Branchiostoma (Leptocardia), (2) the Myxinoids and Petromyzontes (Cyclostoma) and (3) all other fishes (Pisces) except Protoptera, which (4) constitutes a fourth class (Dipneusta). Häckel, moreover, does not consider the fishes as a group coördinate with any combination of other vertebrate classes; contrasting the Leptocardia in a group (Subphylum Leptocardia or Acrania) opposed to all the rest of the vertebrates (Subphylum Pachycardia or Craniota); and under the latter opposing the (1) Cyclostoma in a "cladus" or superclass Hauptklasse Monorrhina), coördinate with (2) another (Anamnia) containing the fishes, "Dipneusta," "Halisauria" (extinct swimming reptiles), and Batrachians, and (3) a third (Amniota) embracing reptiles, birds and mammals.†

In 1868, Prof. Cope,‡ in a suggestive article on the doctrine of evolution, considered the Leptocardii, Dermopteri, Elasmobranchii, Teleostei (including Ganoidei as a subclass) and Dipnoi to be groups coördinate with the Batrachia, Reptilia, Aves and Mammalia and therefore classes: § in a subsequent memoir, he reiterates more distinctly the same opinion, remarking that "The *classes* Aves, Reptilia, and Batrachia are those over which the present review extends. The *classes* of vertebrata not included are: the

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* Agassiz (Louis). Contributions to the Natural History of the United States of America, I. 1857, p. 187 (=Essay on classification, chap. iii, section i).

† Häckel (Ernst). Generelle Morphologie der Organismen, b. 2 (Allgemeine Entwickelungsgeschichte der Organismen), 1866, pp. cxviii-cxxix; also *ib.* Natürliche Schöpfungs geschichte (1868), 2e. aufl. 1870, pp. 512-513, etc.

‡ Cope (Edward Drinker). On the Origin of Genera . . . . < Proceedings of the Academy of Natural Sciences of Philadelphia, 1868, p. 256–265.

§ The groups in question are arranged in the same vertical line in five tables exhibiting anatomical details in which the subordination of groups appears to have been carefully considered and attempted to be represented.

Dipnoi, Pisces, Elasmobranchii, Dermopteri, Leptocardii and the Mammalia.*

Subsequently, in a most important special memoir on the classification of fishes, Prof. Cope † (if I understand his views) recognized (as classes) six groups of Vertebrata; Mammalia, Sauropsida (birds and reptiles), Batrachia, Pisces, Dermopteri, and Leptocardii. After enumerating these groups, he adds: "These six *classes* of Vertebrata appear to be well established."

Three classes among Fishes.—After a careful survey of the field, the author had independently, several years ago, arrived at the same conclusion as Prof. Cope respecting the old class of fishes, but had neglected to announce them except in conversation with others engaged in like pursuit, and in lectures. He had, however, somewhat inclined to the recognition of the Elasmobranchiates as a class, but considers such at present inadvisable and perhaps uncalled for by the evidence; like Prof. Cope, he cannot agree with Prof. Häckel in the separation of the Dipnoans from the class Pisces, the relations of that form with Polypterus and other universally recognized Ganoids being more intimate than those between such Ganoids and the typical fishes. The number of classes recognized as confounded under the common designation of fishes will then be three, viz:—

I. PISCES.

SYNONYMES, AS CLASSES.

<Pisces, *Artedi*, 1738, Linné, 1735-1754 (incl. Cete).
>Pisces. *Linné*, 1756, etc. (excl. *Chondropterygii*, etc.)
>Poissons (Pisces), *Geoff. St. Hilaire*, *Latreille*, 1825.
>Ichthyoderes (Ichthyodera), *Geoff. St. Hilaire*, *Latreille*, 1825.
>Fishes proper, *Agass.*, 1857.
>Ganoids, *Agass.*, 1857.
>Selachians, *Agass.*, 1857.
>Pisces, *Häckel*, 1866.
>Dipneusta, *Häckel*, 1866.
>Dipnoi, *Cope*, 1868.
>Teleostei, *Cope*, 1868.
>Elasmobranchii. *Cope*, 1868.
=Pisces, *Cope*, 1872.
Fishes part., *auct. plur.*

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* COPE (E. D.) Synopsis of the extinct Batrachia and Reptilia of North America, 1869, p. 3; Trans. Am. Phil. Soc., v, 14, p. 3.

† Cope (Edward Drinker). Observations on the Systematic Relations of the Fishes. (Contributions to the Ichthyology of the Lesser Antilles, §I.) <Transactions of the American Philosophical Society (Philadelphia), 2d series, v. 14, pp. 447, 1872.

The same memoir with the same title is printed in the American Naturalist for September, 1871 (vol. 5, pp. 579–593, and in the Proceedings of the American Association for the Advancement of Science, 1871, (1872) pp. 317–343, but without the paragraph cited.

II. MARSIPOBRANCHIATES.

SYNONYMES, AS CLASSES.

<Ichthyoderes (Ichthyodera), *Geoff. St. Hilaire*, *Latreille*, 1825.
<Myzontes, *Agass.*, 1857 (including *Amphioxus*?).
=Cyclostoma, *Häckel*, 1866.
=Dermopteri, *Cope*, 1868, 1872.

SYNONYMES, AS SUBCLASS.

= Marsipobranchii, Bon., 1840 (incl. Leptocardii).
= " Müller, 1844 *et auct. plur.*
< " Bon., 1846.
<Dermopteri, Gill, 1861, Owen, 1863.

III. LEPTOCARDIANS.

SYNONYMES, AS CLASS.

=Myelozoa, *Is. Geoff. St. Hil.*, Bon., 1856.
<Myzontes, *Agass.*, 1857.
=Leptocardia, *Häckel*, 1866.
=Leptocardii, *Cope*, 1868, 1872.

SYNONYMES, AS SUBCLASS.

=Leptocardii, Müller, 1844, *et auct. plur.*
<Dermopteri, Gill, 1861, Owen, 1866.

These three classes appear to be better entitled to such distinction than any of the higher classes of vertebrates, both on account of the greater taxonomic value of their distinctive characters, and their isolation from the next allied forms; and in both these respects, they are, for example, far more worthy of recognition than the classes of birds and reptiles as distinguished from each other, or the Pisces on the one hand and the Batrachians on the other. The difficulty, indeed, in the case of the inferior classes consists not in the inability to distinguish them from each other, but in the task of tracing the homologies between them, and there is no evident reason why this state of facts should not be to some extent reflected in the classification. The chief objection thereto of which the author is aware is a current and vague idea that what are called lower forms are more elastic and exhibit a wider range of variation than superior ones, and by *assuming* that all low forms of any branch, however much they may differ in structure, are constituents of a natural group to be compared with several more restricted higher ones; such views may be enforced, but are liable to be considered, and only worthy of being treated, as *petitiones principii*.

Certainly, the differences between Branchiostoma (*Amphioxus*) and its nearest of kin are as evident and striking as those between

any contiguous classes in the entire animal kingdom;* that, furthermore, they are significant of the highest class taxonomic value is indicated by their fundamental nature, and the coördination of all parts of the organization.

There is also no longer reason for hesitancy in the admission of such a rank on the plea of imperfect knowledge of structure or the supposition that it may be the young of some other form †—a suspicion formerly common to many and shared by the author. With these facts, therefore, something more than mere assertion of opinion is requisite before the title of the group to at least class rank can be questioned.

A much mooted question has been what are the characters of the class of fishes, and how are they distinguished from the class of batrachians. This question has been discussed by Dr. Brandt, of St. Petersburgh, in an elaborate memoir.‡ So long as the fishes, Marsipobranchiates and Leptocardians, were confounded in one class, the extreme variations of the so-called class blinded one to the minor differences that would otherwise have been seized, and the result was that no absolute characters were discovered to limit the so-called class. But the class purged of the Marsipobranchiates and Leptocardians offers no longer such obstacles, and although the characters appear to have been overlooked hitherto, it is not the less true that all the known fishes are absolutely distinguished from all the known batrachians by very

* PARKER (William Kitchen), "On the Structure and Development of the Skull of the Common Frog (*Rana temporaria* L." [Phil. Tr. 1871, p. 202-3], well remarks "The lowest existing fish but one is the Myxinoid (lamprey, hag, Bdellostoma); between it and the lowest vertebrate, the lancelet (*Amphioxus*), there is a gap, the extent of which has never been imagined; and yet even the lancelet itself is not necessarily the boundary form. . . . . Every anatomist will at once see that a creature no higher in type than the unhatched embryo of the frog is yet an untold distance in advance of the lancelet which yet is only the *known lowest* of the great vertebrate subkingdom.

† BERT (P.) Sur l'Amphioxus. Note de M. P. Bert. . . . . <Comptes rendus hebdomadaires des séances de l'Académie des Sciences (Paris), t. 65, 1871, pp. 364-7; translated (On the anatomy and physiology of Amphioxus) <The Annals and Magazine of Natural History, third series, 20, 1867, pp. 302. Contains notes on the ejection of semen, etc.

KOWALEVSKY (A.) Entwicklungsgeschichte des Amphioxus lanceolatus. . . . 1867. [4to. 1 pl., 17 pp. 3 pl.] < Mémoires de l'Academié Impérialo des Sciences de St. Pétersbourg, viie Série, t. xi, no 4.

An account of the development of the species. The eggs are expelled through the mouth.

‡ BRANDT (Johann Friedrich). Bemerkungen über die Classification der Kaltblütigen Rückenmarkthiere zur Beantwortung der Frage Was ist ein Fisch? . . . . St. Petersburg, 1865 [4to. 1 pl., 30 pp.] = Mémoires de l'Académie Impériale des Sciences de St Pétersbourg, 7e série, t. 9, no. 3.

obvious ones. All the batrachians have a scapula (in the broadest sense) which is homogeneous, the only differentiation being in the simple ossification of parts and which is always confined to the side; on the other hand, in all the fishes the shoulder girdle has somewhat the form of the furcula (wish-bone) of a bird, and really forms a girdle behind the head, inclining forward and connected below, either by a median cartilage or directly, and a wholly differentiated element (answering to the paraglenal or coracoid * region of Batrachians), or elements, support the pectoral member. The Dipnoans (Lepidosiren, etc.) and all other fishes agree in this respect and differ from the Batrachians.

In conclusion the following analytical synopsis (extracted from the author's "Arrangement of the Families of Fishes," published by the Smithsonian Institution) will exhibit the principal characters which distinguish the several classes confounded under the name of Fishes. The characters used are supplemented by many others: —

CLASSES.

I. Skull more or less developed, with the notochord not continued forwards beyond the pituitary body. Brain differentiated and distinctly developed. Heart developed and divided at least into an auricle and ventricle.

A. Skull well developed, and with a lower jaw. Paired fins developed (sometimes absent through atrophy); and with a shoulder girdle (lyriform or furcula-shaped, curved forwards and with its respective sides connected below †), and with pelvic elements. Gills not purse-shaped. PISCES.

B. Skull imperfectly developed and with no lower jaw. Paired fins undeveloped, with no shoulder girdle nor pelvic elements. Gills purse-shaped. MARSIPOBRANCHII.

II. Skull undeveloped, with the notochord persistent and extending to the anterior end of the head. Brain not distinctly differentiated. Heart none. LEPTOCARDII.

* This is generally multiple, and its elements have been identified with the radius, ulna, and humerus (Owen = third bone of the fore-arm of Cuvier). In a special article, I have discussed these homologies.

† The shoulder girdle of the Elasmobranchiates appears to be homologous with the paraglenal or coracoid elements of the specialized fishes, the proscapula of the latter having been apparently first developed by exostosis in the Ganoids, and finally become preponderant while the Paraglenal became proportionately reduced.

NOTES ON THE HABITS OF CERTAIN CRAWFISH.

BY CHARLES C. ABBOTT, M.D.

In the course of a day's fishing during the past month of September, my companion and myself caught a large number of those lobster-like crustaceans, known everywhere as "Crawfishes;" and by zoologists, as either Cambarus or Astacus, the former differing from Astacus in having a more elongated body, "by the absence of the gill on the fifth pair of legs," and other slight differences, not noticeable except upon careful examination.

The crawfishes found in New Jersey all belong to the genus Cambarus; and of this genus, certainly three species, viz., *Cambarus acutus* Girard, *Cambarus affinis* Say, and *Cambarus Bartonii* Fabricius, are found either in the streams and ditches near, or in the Delaware River, at Trenton, New Jersey.

It is difficult to say which of the three species is the most abundant in the general locality we have named, inasmuch as they seem to prefer different streams; one being a plant-loving, one a stone-haunting, and the third, a mud-frequenting species. In their respective haunts, each is apparently as numerous as is either of the others in their chosen home.

During the past month (September), as a result of a thorough examination of many small streams, as well as of the Delaware River itself, we have found the *Cambarus acutus* to frequent running streams, which have masses of vegetation growing in them, the animal in question resting upon the plants, usually near the surface of the water. We have found since our collecting excursions, on carefully approaching clear, running streams, such as just mentioned, that this crawfish is to be seen resting on the plants always with the head directed down stream. If disturbed, they would dart backwards down to the roots, apparently, of the plant upon which they were sitting. After a lapse of about ten minutes they would return to their former resting-place creeping up the plant down which they had so suddenly darted tail foremost.

The *Cambarus affinis* is apparently *the* river species of this locality. We have been able to find it, as yet, only in the Dela-

ware River, usually frequenting the rocky bed, but also, in fewer numbers, on the mud-bottomed portions of the river. They are usually found resting under flat stones, well out from the banks of the stream, where the water is of considerable depth. Wherever the vegetation is dense, we have failed to find them; nor have we seen anything to indicate that it is a "burrowing" species.

Dr. Hagen, in his "Monograph of the North American Astacidæ," which work we have followed exclusively in identifying the specimens we have collected, says, on page 62, "The *Astacus limosus* Rafinesque (Amer. Monthl. Mag., t. 2, p. 42) from the muddy banks of the Delaware" is apparently the same species as *Cambarus affinis*. While we have no reason, really, to doubt the correctness of this assertion, we may say that the specimens we have collected during September were none of them from the "muddy banks," but from the *bed* of the river; although in such banks we found many crawfish, of a very different species, as we shall see.

The *Cambarus Bartonii*, it appears to us, is the one burrowing species of this locality. We have found in the deep ditches, with precipitous, muddy banks, a medium sized crawfish, that in most respects, accords with the species called *Cambarus Bartonii* Fabr., by Dr. Hagen, on page 75 of his Monograph.

We have purposely said "in most respects," inasmuch as there is a considerable range of variation between the many examples that we have collected. Dr. Hagen says of this crawfish it "is the most variable species; as yet I cannot find stable and constant characters for dividing them into three or four species, as Mr. Girard has done."

It is this species, we doubt not, that Dr. Godman found near Philadelphia, and has referred to, as follows, in his "Rambles of a Naturalist," which we find printed with the second volume of his "American Natural History," third edition: Philad., 1842. Dr. Godman says,—"I now returned to the little brook and, seating myself on a stone, remained for some time unconsciously gazing on the fluid which gushed along in unsullied brightness over its pebbly bed. Opposite to my seat was an irregular hole in the bed of the stream into which, in an idle mood, I pushed a small pebble with the end of my stick. What was my surprise, in a few seconds afterwards, to observe the water in this hole in motion, and the pebble I had pushed into it gently approaching the surface. Such was the fact; the hole was the dwelling of a stout

little crawfish or fresh-water lobster, who did not choose to be incommoded by the pebble, though doubtless he attributed its sudden arrival to the usual accidents of the stream, and not to my thoughtless movements. He had thrust his broad lobster-like claws under the stone, and then drawn them near to his mouth, thus making a kind of shelf; and as he reached the edge of the hole, he suddenly extended his claws, and rejected the encumbrance from the lower side, or down stream. Delighted to have found a living object with whose habits I was unacquainted, I should have repeated my experiment, but the crawfish presently returned with what might be called an armful of rubbish, and threw it over the side of his cell, and down the stream as before. Having watched him for some time while thus engaged, my attention was caught by the considerable number of similar holes along the margin and in the bed of the stream. One of these I explored with a small rod, and found it to be eight or ten inches deep, and widened below into a considerable chamber, in which the little lobster found a comfortable abode. Like all of his tribe, the crawfish makes considerable opposition to being removed from his dwelling, and bit smartly at the stick with his claws: as my present object was only to gain acquaintance with his dwelling, he was speedily permitted to return to it in peace."

There are some points in this pleasing description of the haunt of a burrowing crawfish that differ from the results of our own observations. It will be noticed that the principal description is of a "burrow" or hole in *the bed* of the stream, facing against the current. This is more in accordance with what we have noticed of the habits of *Cambarus affinis*, which species, however, appears merely to take shelter under stones; and the burrows of *Cambarus Bartonii*, so far as we have discovered them, have all been *in the banks* of the smaller streams and meadow ditches (and occasionally, a colony of burrows *in* the river bank, where peculiarly favorable), a little below the usual water line.

The crawfish that we have found inhabiting such burrows, located as we describe, besides showing anatomical specific differences, will thrive admirably, we find, in an aquarium, where the water is, of course, quiet; while both the others die very soon after being taken from their natural habitats. This fact, we think, is of itself quite sufficient to show a decided difference between a burrowing and a running water species, even if no anatomical variations could be traced.

Dr. Hagen refers to the quotation from Dr. Godman, speaking of the crawfish, of which the latter writes, as *Cambarus Diogenenes* Girard, and considers it to be the same as *C. Bartonii* Fabricius; although it seems to bear some resemblance to *C. obesus* Hagen, a southern and western species. One fact is certain, at least, that the specimens observed by Godman were in a stream near Philadelphia, a locality familiar to Girard. We have found no specimen about Trenton, New Jersey, that could be identified with *C. obesus* Hagen, although we have made very careful search, hoping to find more than the three species we have mentioned.

Crawfish are strictly omnivorous animals but, although excellent scavengers, do not feed wholly upon decayed animal and vegetable matters. We have frequently noticed that *C. Bartonii* in an aquarium breaks off the short stems of the common river-weed, and eats the main stem, after stripping it of its minute leaves. So too *C. affinis*, from beneath its sheltering flat stone, and *C. Bartonii*, in its safe burrow, will seize the minute young Cyprinoids, that pass up and down near the stream in such myriads, ever and anon peeping into the various little indentations in the banks. Such little fish when once fairly caught by the big, but by no means clumsy, "hands" of a Cambarus, have no chance of escape, and are soon torn in pieces and devoured.

Etheostomoids, or "darters," that habitually rest upon the bottoms of the streams they frequent, will usually take shelter underneath a stone, if one be near, when they are disturbed either by larger fishes, or by man. When a crawfish happens to have taken up his abode under such a stone, it is seldom that the frightened "darter" escapes. Often have we seen the common *Boleosoma Olmstedi* take refuge as we have described and found, on examination, a Cambarus quietly resting underneath the stone, with the luckless "darter" in his claws.

Having had our attention particularly called to these crustaceans, during the past month of September only, we have, of course, noted nothing of their breeding habits; but the very great numbers of very small specimens half an inch to an inch and one half in length that we have found, seem to indicate that the animal is of slow growth during the first summer of its existence; and on the other hand, we have failed to find any specimens of *C. acutus* more than four inches in length, the maximum size being six and three-tenths inches, as given by Dr. Hagen.

Dr. Hagen mentions six specimens from Essex (Co.?) New Jersey, however, that were smaller than the above figures quoted from his work, being, to use his own words, "Long. corp. 3 ad 4 inch." He thinks it quite possible that these may "belong to a different species (viz., *Cambarus Blandingii*), a South Carolina form.

The young Cambari, in September, seem to be fully as active as the adults, but do not frequent any given class of localities, as they wander about the beds of streams, creeping forward in a slow, awkward manner, and swimming backwards, when disturbed, with wonderful rapidity.

It has seemed curious to us, that we have found no dead specimens of crawfish. In what manner their unattractive bodies are disposed of after death we cannot imagine. We have tried, too, in vain, to find out their enemies; but have failed to do so. We should judge that if at all preyed upon, it must be when they are but a few weeks old. But what becomes of their adult dead? Do they, as birds are asserted to do, seek some hidden nook? or do they dig their own graves deeply in the mud, preparatory to the approaching dissolution, which they feel is near at hand?

The precise number of species of this crustacean, inhabiting the streams of New Jersey, we do not doubt, will prove to be more than the three that we have mentioned; but as yet these are all that we can readily distinguish among the many dozens that we have gathered in our immediate neighborhood. The differences that mark these species, according to Dr. Hagen, are found to be coexistent with our separation of the specimens, in accordance with the different classes of localities where found; we can therefore scarcely think that there is any error in asserting that the crawfish found in the neighborhood of Trenton, New Jersey, are respectively, *Cambarus acutus*, *affinis* and *Bartonii;* the first, a plant-loving species: the second, a deeper water, stone-haunting form; the third, a burrower in the muddy banks of ditches, small streams and, occasionally, of the river itself.

THE RATTLE OF THE RATTLESNAKE.

BY PROFESSOR SAMUEL AUGHEY.

I wish to contribute my observations on the rattlesnake, having been specially favored in opportunities for the study of this reptile.

Of all the articles that have appeared on the subject in the NATURALIST that by Mr. Putnam* appears to me to present the most satisfactory theory concerning the use of the rattles. I am satisfied that *one* of their uses is to bring the sexes together.

In July, 1869, I was engaged in surveying along the Logan river in Wayne County, Nebraska. After completing my contract I devoted a day to investigating the natural history of the neighborhood. While washing a collection of unios at the water's edge, I heard the familiar rattle of the Massasauga (*Crotalophorus tergeminus*). I quietly crept up the bank and cautiously looking over the level bottom I saw, at the distance of about thirty feet, a rattlesnake coiled up with head erect and gazing in an opposite direction from my position. Every three or five minutes the snake would cease rattling for a minute or more and then commence again. In about half an hour from the time that I first saw the snake I observed another rattlesnake approach the first one. Closer and closer the second one approached, until at length they met and indulged in a sexual embrace. I watched them for at least an hour and left them at last without disturbing them.

The next year at the Bow river in the same state I saw the same thing repeated under similar circumstances. In neither case could I ascertain whether it was the male or female that gave the call.

I am satisfied that the theory† that the rattle resembles the noise made by the Cicada, and that it is employed because of this resemblance to entrap birds, etc., is a mistake. I have been accustomed to the sound of the Cicada and the rattle of the rattlesnake from my youth, and soon learned to distinguish them, although there is betimes a striking resemblance between them. My familiarity with them was gained in my native state amid the Alleghanies of

* AMERICAN NATURALIST, Vol. VI, p. 693. † *l. c.* p. 32.

Pennsylvania. In the last week of June, 1869, I was on the Missouri flood plain in a dense timber in Cedar County, Nebraska. At the time there were many Cicadæ and multitudes of birds in the timber. One day I was sitting on a log, classifying a collection of flowers and plants. Suddenly I heard the well-known rattlesnake rattle. The snake was not more than forty feet from me. I could not have been the cause of its alarm as a large log lay between us and I had been quiet for nearly an hour. Even the Cicadæ were alarmed and disappeared, and soon not a bird was to be seen, but the rattling continued. Unfortunately, on the impulse of the moment, I killed the snake without waiting to see or learn the purpose of its rattling. Again I have noticed that the Massasauga, at least in Nebraska, is by far the most abundant far away from the timber, where the Cicadæ are rarely if ever seen.

These observations seem to me to point to the theory that the rattle calls the sexes together. In July, 1871, I was in the timber on the Missouri in Dakota County, Nebraska. I got sight of a Baltimore oriole (rare in Nebraska) which I was following as it flitted from twig to twig. As it swept near the ground a rattlesnake struck his highest notes and seemed to paralyze the oriole with fear. This snake was a Crotalus. The poor bird hovered near the snake and fearing that it might fall into its jaws I shot the reptile. This experience suggested the theory that perhaps an additional purpose of the rattle was to frighten its victims into submission and to protect itself by the terror it inspires from its natural enemies. However that may be, is it not a mistake to limit such a peculiar organ to any one single purpose? What is needed to determine definitely the natural history of the rattlesnake is closer and more accurate observation over a wide area, and by persons who are fitted by nature and education for such work. Unfortunately for science, the almost universal custom has been to kill the rattlesnake as soon as found, without waiting to learn its disposition and habits of life.

Once in the Dakota Nebraska timber I saw an attack of hogs on a rattlesnake. In a few minutes after the snake commenced rattling, three others made their appearance. They apparently came to the assistance of the first one, but all were killed by the hogs in a few minutes. Seven hogs were more than a match for four rattlesnakes. Here evidently the rattle was used to call for help. These belonged to the genus Crotalophorus.

COLOSSAL CUTTLEFISHES.

BY A. S. PACKARD, JR.

There is a prevalent opinion among seamen that the largest being that swims is a colossal squid or cuttlefish. As a matter of fact there are immense squids which range the high seas, often forming the food of the sperm whale. It is these gigantic animals which have on rare occasions been seen by fishermen and others, which have given rise in past ages to the stories of the kraken. This animal was supposed to be large enough to form islands in the sea, and the well-known hoax of Denys Montfort represents a "kraken octopod" in the act of scuttling a three-masted ship. The first authentic records of these colossal squids will be found in a forthcoming memoir by Professor Steenstrup, the distinguished Director of the Zoological Museum of the University at Copenhagen. From the proof-sheets and copy of the first plate illustrating it which he generously placed in my hands, I find several authentic cases of the occurrence of gigantic squids on the European coast. In the middle of the sixteenth century (1549) there was found at Malmö, in Sweden, a large squid, called monk fish or sea monk (sömunk), and designated by Gesner as *Monachus marinus.* We shall refer to this animal again.

In 1639, 1798 and 1853, specimens of gigantic squids, now preserved in the museum at Copenhagen, occurred on the north coast of Denmark, and in 1662 another animal of this sort, the *Ommatostrephes pteropus* of Steenstrup, portions of which are in Prof. Steenstrup's collection, was found on the coast of Holland.

The specimen found in 1853, on the shores of the Cattegat, was represented only by the horny beaks which were over four inches in length (about the size of the beak figured on page 93). This is described by Prof. Steenstrup under the name of *Architeuthis monachus.*

The most interesting discovery, however, was from the neighborhood of the Bahamas, in latitude 31° N., and longitude 76° W. Specimens of the horny jaws, hooks, arms, sucking disks and other parts of a cuttlefish over eighteen feet long, were brought

to Copenhagen by Capt. Hygom from this locality in 1855. This species was named by Prof. Steenstrup *Architeuthis dux.**

This kind of cuttlefish, called the hooked calmary, is found swimming on the high seas, being solitary in its habits, not going in schools as the common squid. The end of the body and an arm of one of these hooked calmaries, thought by Prof. Owen to have belonged to an individual six feet long, are preserved in the museum of the College of Surgeons in London where, owing to the kindness of Prof. Flower, we had an opportunity of seeing it. The arms of this calmary are provided with large hooks arising from the centre of the suckers, which must add a peculiar horror to the slimy monster. It was found by Banks and Solander, the naturalists of Cook's first voyage, near Cape Horn. It was named by Prof. Owen *Onychoteuthis Banksii.*

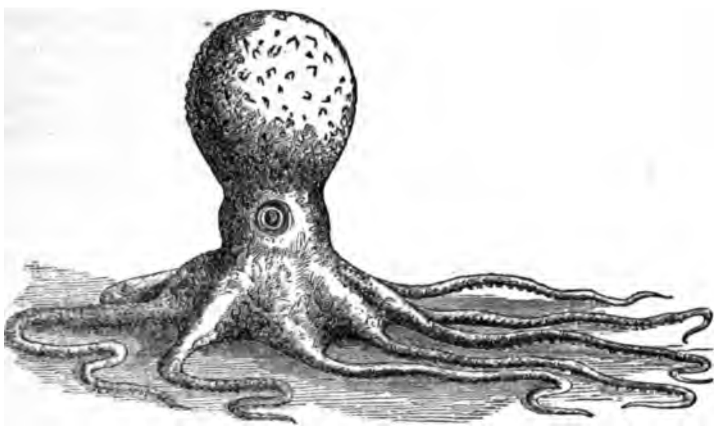
The French naturalists Quoy and Gaimard, as reported by Woodward in his "Manual of Mollusca," found a dead cuttlefish in the Atlantic under the equator, which must have weighed two hundred and twenty pounds when perfect. It was floating on the surface, and was partly devoured by birds. To the same excellent authority we are indebted for the statement that a kind of squid called the "sea arrow," used extensively for bait in the codfishery of Newfoundland grows nearly four feet in length. This possibly belongs to the genus *Ommatostrephes.*

We are indebted to "The World of the Sea" by M. Moquin Tandon, for the following statements regarding large cuttlefish. Pliny notices an enormous cuttlefish which haunted the coast of Spain devouring all the fish, and destroying the fishing grounds. It weighed seven hundred pounds, and its arms were more than thirty feet long. Aristotle speaks of a great calmar more than ten feet long which was taken in the Mediterranean. In modern times M. Verany speaks of a calmar a yard and a half long, and which weighed twenty-four pounds. One was caught near Nice, weighing fifteen pounds. An equally large one was found in the Adriatic, and its body is still preserved in the museum at Trieste. Over twenty years ago a calmar six feet long was caught off the south coast of France; it is still to be seen in the collection of the Faculty of Sciences at Montpellier. Peron, a French naturalist, met in the Australian seas a huge cuttlefish with arms more

* In the proof it is called A. Titan, but Prof. S. mentioned it to me in conversation as *A. dux.*

than eight feet long. Rang, in the same part of the world, met a cephalopod with a reddish body, which was the size of a ton cask. Swediaur reports that some whalers took out of the mouth of a whale pieces of a cuttlefish which were twenty-five feet long. On the 30th of November, 1861, the steam corvette Alecton, while cruising between Teneriffe and Madeira, encountered a monster cephalopod floating on the surface of the water. It was sixteen or eighteen feet long, irrespective of the eight long arms. The body was fusiform and weighed upwards of four thousand pounds. It is doubtful whether this creature was a true cuttlefish or not, but as its body is said to be fusiform and terminated in two fleshy lobes or fins, the two long arms may have been eaten off. The poulpes or octopods have no fins, and the body is a rounded mass, as seen in the adjoining figure, which represents a true octopus (a

Fig. 9.



Brazilian species), so that this was probably a cuttlefish.

I have been informed by Capt. J. Hammond of Salem, who has sailed for forty-one years between that port and the East Indies, that once, while off the Cape of Good Hope, he saw the remains of squid from eight to ten cubic feet in size, floating on the surface. The animal had apparently been attacked by whales and dolphins, and the arms and head devoured.

At a late meeting of the Boston Society of Natural History, Hon. N. E. Atwood related the fact that he had seen pieces of squid ten inches in diameter vomited up by a sperm whale, and that sperm whales were known to devour giant squid. I have re-

ceived the following letter from Captain Atwood reiterating these and other facts:—

"PROVINCETOWN, December 16, 1872.

DEAR SIR:—Your letter, asking me some questions about the size of the large squid of which I spoke in my remarks at a late meeting of the Boston Society of Natural History, was duly received. In regard to the large squid seen by whalers in every ocean where sperm whales are found, I would say that I think some of them are very large. I have made but one whaling voyage, and that was in the Atlantic, when I was a boy fifteen years old. I have not seen a piece of large squid since. I think I did then see some heads that were at least ten inches in diameter. Some of our whalemen here who have had many years' experience in whaling say they have seen them much larger than ten inches, but I find no one who has measured them, therefore they cannot give me anything definite in regard to their size.

It is the opinion of almost all whalemen that the sperm whale feeds wholly on squid. I have been informed by some of my neighbors (who are reliable), that they made a voyage in a schooner from this port, and when they were killing a large sperm whale, it threw up a shark some ten feet long. This is the only instance that I have ever heard of sperm whales eating anything but squid.

I refer you to Lieut. Maury's "Sailing Directions," in which he records several letters from whaling captains who have had much experience in the business, from which I make the following extracts:—Captain Daniel McKenzie of New Bedford says, 'The principal article of food (and indeed the only one as far as I know) is squid; the smaller kind they eat is found near the surface, and is from two to three feet in length; the larger kind, which probably have their haunts deep in the sea, must be of immense size: the flesh soft and of gelatinous substance. I have seen very large junks floating on the surface entirely shapeless.' Captain Francis Post says 'Cuttle or squid, supposed to be the only food which sperm whales ever eat, are often found in shoal water; there is, however, a species of this fish, the exact size of which is not known, but it is presumed to be large, as whales in the agony of death frequently eject from their stomach pieces as large as the bulk of a barrel, and these in large quantities; so that the assertion of the naturalists that the whale, though the largest of animals, is one of the smallest eaters, is untrue. Large pieces of squid are often seen floating on the sea, which whalers consider indicate good whale ground.' Capt. Roys writes to Lieut. Maury, dated Hong Kong, January 19, 1851: 'The sperm whale is found in all climates, and in every sea; he feeds upon an inanimate animal substance called a squid, which grows upon the bottom of the sea, and is never seen upon the surface, except

when torn up by the whale. I have seen it in large pieces floating upon the surface. I have seen a dying whale vomit it up. I have opened the stomach of a whale and seen it there in pieces, which convinces me that the animal is very large also, as well as small; and that the sperm whale almost always when in want of food goes to the ocean bed.' Captain Rose, of the bark Dove, writes under the date of June 1, 1854, as follows: 'Fifteen years ago I might have agreed with Captain Roys, that sperm whales' feed [*i.e.* squid] lived or grew on the bottom of the sea, and it may live there; but as to its never being seen unless torn up by whales, I know and can support the assertion that in some seasons and places it is seen on the surface of the water both alive and kicking. I have seen them often on the southeast coast of Arabia, mostly in the morning, dodging across the bows and in the wake of the ship.'

The above extracts will show you that the whalemen, who have have had much experience, give us nothing definite in regard to the size of the squid."

In confirmation of this and other statements to the same effect, we may cite a similar statement from an old whaler, given in Prof. Shaler's article on the "Habits of the Sperm Whale," on page 3 of the present volume of this journal.

It now remains for us to notice briefly the facts regarding the colossal squid that have come under our own notice. In the autumn of 1871 appeared a statement in the "Cape Ann Advertiser" that the crew of a Gloucester fishing vessel, while upon the Grand Banks, found a squid, floating dead, which measured fifteen feet in length and four feet six inches in circumference, the longer arms measuring ten feet. On writing to the editor, and inquiring how far this statement could be relied on, he kindly wrote in reply as follows: —

"The account of the squid, as published in the "Advertiser," is correct, and is vouched for by Mr. James G. Tarr, of the firm of Dodd, Tarr & Co., of East Gloucester. The squid was picked up afloat (dead) at the place mentioned, and was so large that they had to take their tackle to get it aboard the vessel. They cut up one-half to bait their trawls, and caught with it one hundred quintals of fish. The skeleton might have been brought in as well as not; but sailor-like, they did not think of it."

From Mr. Tarr I also received the following letter, giving more precise details: —

"East Gloucester, January 4, 1872.

Your note of the 22d ultimo came duly to hand. In reply I would say that Captain Campbell of the schooner B. D. Haskins,

while lying at anchor on the Grand Banks on or about the 20th of October, discovered something floating on the water, perhaps a gun-shot from his schooner. The weather being fine and pleasant he ordered the boat lowered, and sent two men to learn what it might be; they returned reporting the object to be a mass of floating jelly, or something unknown to them. The Captain then with hooks and gaffs and more men went to investigate; he found it quite dead, each end hanging under water, only the centre on its surface. After towing it alongside the schooner, he took his purchase or halyards to hoist the monster out of water, and on seeing its head, declared it to be a squid, saying he had heard of squid of that size, but never saw the like before. After it was got on board, the second hand or mate informs me he measured the body with a rule and found it fifteen feet long, four feet eight inches round. The long arms were badly eaten; judged they might be nine or ten feet long; two were shorter than the former, perhaps two or three feet; did not measure the arms, but judged them twenty-two inches round; also judged its weight to be two thousand pounds, and would fill eight or ten barrels. The biggest squid usually found on the banks is about one foot long. Enclosed I hand you the size or form of one of its beaks or bills. The original is in the hands of one of our workmen who declines to part with it. I learn from some older fishermen that years ago large squid were often taken on the Grand Banks, and whalers have often seen them in northern oceans of immense size, larger than any whales. One old gentleman has seen an arm taken from a captured whale that measured forty feet in length. I think the large squid is often found in the northern oceans."

Learning from Mr. Tarr that one of the crew had the horny jaws of the monster in his possession, I offered him a fair price for it for the museum of the Peabody Academy of Science, but he would not part with it. Through the kindness, however, of Mr. Tarr, I was enabled to obtain an imperfect photograph of it. The beak had been split open and spread apart, and photographed in this position. I took a photograph of it to Prof. Steenstrup who kindly spent some time with me in endeavoring to identify it from the specimens in the unrivalled collection of decapodous cephalopods in the museum of the Royal University. He decided that in all probability, so far as could be decided from such imperfect data, the beak must have belonged to the *Architeuthis monachus* Steenstrup. This is the "sea monk" which we have previously noticed as having occurred on the coast of Cattegat in 1853, and which was also known to the naturalist Gesner, who wrote in the middle of the sixteenth century. I also showed Prof. Steenstrup

the proof of the accompanying cut (Fig. 10), of the beak of a squid, which was presented by Hon. N. E. Atwood to the Essex Institute several years ago. It is four and a half inches long, the cut being of the natural size. The specimen was taken from the

Fig. 10.

stomach of a sperm whale, captured in the North Atlantic, and is now in the Museum of the Peabody Academy of Science. Judging by this cut, Prof. Steenstrup ventured the opinion that it belonged to *Architeuthis dux* which, as we have stated above, has been previously found near the Bahamas. He also suggested that the

smaller figure (natural size) in the cut, illustrated the beak of another small squid, the *Gonatus Fabricii*. A beak of this squid was presented by Captain Atwood at the same time with that of *A. dux*, and we suppose it may have come from the same sperm whale, but there is no statement to that effect. These specimens will all be sent to Prof. Steenstrup for accurate determination. When his memoir appears we hope to be able to present our readers with a more satisfactory account of these, until lately almost fabulous, monsters of the deep. I may however not be trespassing on the kindness of Prof. Steenstrup if I say that I had the pleasure of examining a squid, perfectly preserved in spirits, with arms about twelve feet long; the body as well as I can remember being between two and three feet in length, which he had just received from Iceland. Its discovery has undoubtedly before this been announced in Danish jonrnals.

We have said nothing of colossal Octopi, or poulpes. We published an account of one, however, in the last number of the NATURALIST (page 772) which had been found at the Bahamas. The daily papers had a notice of one thirty feet in length, seen near Newfoundland during the past summer, but much allowance must probably be made for the statement. Prof. Brewer, of Yale College, tells me that he has seen them measuring fourteen feet from tip to tip of the expanded arms in the San Francisco markets. Accounts of colossal species of Octopus are not uncommon. They occur in the mid-Indian, Atlantic and Pacific oceans, and seem to be as large and much more common than the ten-armed squids.

ON THE POTTERY OF THE MOUND-BUILDERS.

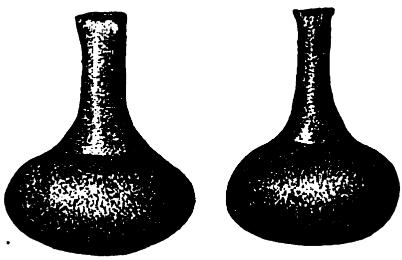
BY J. W. FOSTER, LL. D.

In the specimens of pottery which have been recovered from the mounds, there is displayed a skill in the selection of the materials, and in the moulding of them into artistic forms, which far surpass the specimens which are characteristic of the Bronze Age of Europe. The commonest forms represent kettles, drinking cups, water-jugs, pipes and vases in the nature of sepulchral

urns. The Mound-builders, not content with plain surfaces, often decorated the exterior of the vessels with scrolls, chevrons and indentations; they even went further, and modelled the effigies of birds, animals, and of the human form. The clay, except for their coarsest utensils, such as kettles, etc., where gravel was often introduced, was finely tempered, so that it did not warp and crack in burning,—the utensil when completed having a yellowish or grayish tint. Most of their pottery was unglazed; but in one instance, hereinafter to be described, the additional process of glazing was resorted to.

WATER-JUGS.—These utensils are quite abundant, and appear under a variety of forms. Being unglazed, they would permit water to permeate slowly through the pores, and thus, by evaporation, produce a temperature below that of the surrounding air, —a device resorted to, at this day, in tropical climates, to keep water cool.

Fig. 11.



Water-Jugs from Perry County, Missouri. = ½.

The subjoined figure represents two water-jugs, which are similar in shape to the decanters formerly furnished the guests of a hotel, before the days of water-works. They were taken from an ancient cemetery in Perry County, Missouri, and were found occupying a position near the head of a corpse. Height, 8 inches.

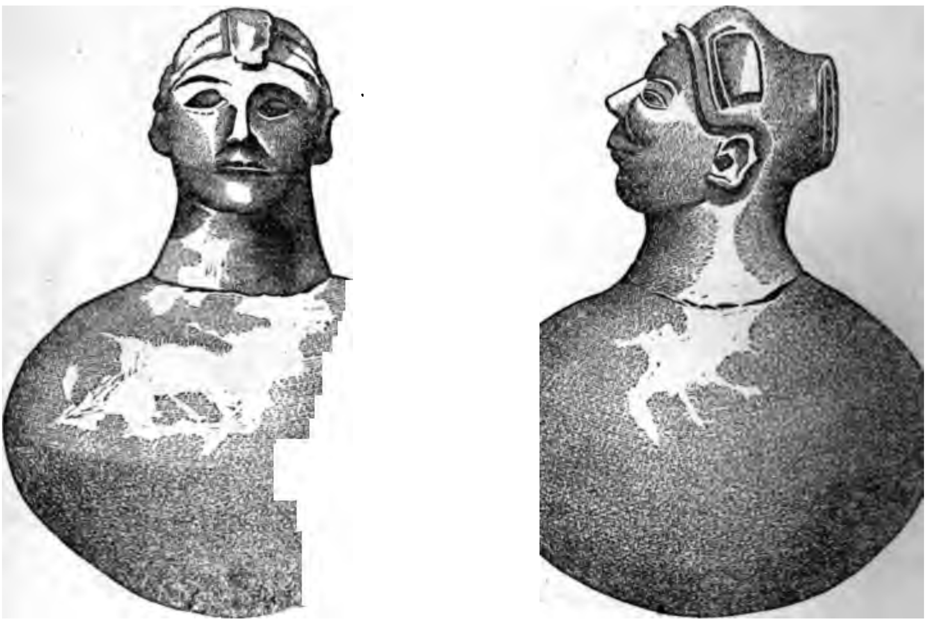
Figure 12 represents a fine specimen of ancient modelling. The body consists of a compressed globe, surmounted by a human head. The orifice in the region of the occiput, is about half an inch in diameter; the height of the figure is 8½ inches.

When we examine this head critically we are convinced that the unknown artist had the skill to impress upon the plastic clay the features of his race. Those features are not characteristic of the Red man. The facial angle is not as obtuse as in the European; the eyes have not the obliquity of the Indian; the jaws are not extraordinarily prognathous, and altogether, the contour of the face is indicative of intelligence. The head is covered with a fillet, the material of which was probably cloth. Have we in this model the characteristic features of the Mound-builder? It is not

a caricature; there is nothing grotesque; but there is a display of artistic skill which could impress upon the clay whatever type the modeller had in his mind.

Figure 13, on the next page, represents a profile and back view of a statuette. His head is covered with several plaits of cloth; his eyes are closed; his face is contorted, as if in pain; his arms are pinioned with a strong cord; the bones and muscles of his shoulders are brought out in strong relief; and while these points are well delineated, the lower extremities are grossly incongruous.

Fig. 12.



Water-jug from near Belmont, Missouri. = ½.

This figure may have been designed to commemorate the capture of some dangerous enemy, or some notorious malefactor; or, as it is now pretty well ascertained that the Mound-builders offered up human sacrifices, it may represent a victim prepared for the altar. There is an opening at the top of the head, and the marks of the gouge with which the superfluous clay was extracted are plainly visible. Height, 8 inches.

These two vessels last described were exhumed by the late Sylvester Sexton, of Chicago, from a low mound in Mississippi

County, Missouri, about seven miles from the battle ground of Belmont. There was also found a plain water-jug, of about the capacity of that described as Figure 12. Statuettes of a similar character, but less artistically executed, are in my possession from the ancient cemetery in Perry County, before referred to. In all instances they were found near the head of the corpse, and appear to have been offerings consecrated to the dead.

The Wabash Valley, throughout its entire course, appears to have been a highly favored region to the Mound-builder. About

Fig. 13.

Statuette from near Belmont, Missouri. = ½.

twenty miles above the mouth of this stream, on the Indiana shore, there is a high bluff, the site of an ancient cemetery, in which great quantities of human relics from time to time have been unearthed by the excavating power of the river. Among these may be enumerated bones, ash-heaps, stone-axes and arrow-heads, and pipes and vessels of pottery. At a point still further south, was recovered a water-jug which in its general outlines is similar to that from Missouri (Fig. 12). Figure 14 is a representation of this utensil, the height of which is 6 inches.

It is difficult in this figure to determine precisely what the artist designed to represent, but the nearest approach among the feathered tribe would be the horned owl. The eyes are large and circular, the beak is short and divided, the head is crowned by two projections which may be taken for tufts of feathers, and yet to the cheeks are attached the appendages of human ears, which are pierced for the reception of ornaments.

Fig. 14.

Water-jug found near the mouth of the Wabash by David Septer, and presented to Prof. Cox of Indianapolis, by Dr. J. W. Berry. = ½.

It is not often that we meet with vessels supported by feet, yet a few such instances occur. Figure 15 is a representation of one belonging to this class, which was found in a ploughed field, near Belmont, Missouri, by William J. Hough, of Paducah, Kentucky, and kindly loaned by the present owner, Daniel Hough, of Indianapolis, for this illustration. This attachment is common in the ancient pottery of Mexico and Central America.

Fig. 15.

Water-jug from near Belmont, Missouri. = ½.

For the purposes of comparison, I introduce the figure of a vessel from San José, near Mexico (Figure 16), one of a series forming the Scammon Collection of Ancient Pottery, belonging to the Chicago Academy of Sciences. It is symmetrically moulded, and is of a uniform reddish tinge, which would indicate that it was burned in an oven, rather than in the open air. What is particularly noticeable, in view of what I shall state hereafter, is the series of *chevrons*, or small triangles, with which the rim is decorated. This chevron

mode of decoration appears to have been widely prevalent, and not confined to this hemisphere. The most beautiful specimen of ancient pottery of the Mound-builder epoch, which I have ever seen, was a cup recovered from a shell bank on the borders of Grand Lake, Louisiana, by Dr. Dungan, of Jeaneret's, and deposited in the collection of the Chicago Academy of Sciences, but unfortunately destroyed in the memorable fire of October 8, 1871. It was hemispherical in form, and glazed with a pigment of a rich umber color, except where ornamented, in which the groundwork was reddish. This is the only instance of *glazed* pottery, which, to my knowledge, has been found on the Gulf coast. In the accuracy of detail and in the graceful lines of the contour, this vessel reminded me strongly of the best specimens of Japanese pottery of the present day. The rim was ornamented by the same system of chevrons seen in the preceding specimen, with this addition, that below the line defining this work there was a scroll-like border of harmonious outline. At first I was disposed to regard this similarity of marking as a signal fact demonstrating a filiation between the ancient inhabitants of the two regions, but I

Fig. 16.

Ancient vessel from San José, near Mexico. = ½.

Fig. 17.

Pottery of the Bronze Age, Switzerland. = ½.

Fig. 18.

Drinking cup from an ancient grave, Perry County, Missouri. = ½.

Fig. 19.

Pipe from a Mound near Laporte, Indiana.

subsequently found that precisely the same device was used by the people of the Bronze Epoch of Switzerland, as will appear from the accompanying illustration (Fig. 17), which is a reproduction of figure 27 *a*, as given by M. Desor, in his paper on the "Palafittes of Lake Neufchatel."

DRINKING CUPS.—These relics often display much taste in form and ornamentation. Figure 18 is a representation of one found in the ancient cemetery in Perry Co., Missouri, before referred to. It will be seen that there is a flat lip attached to the rim, and that the handle is surmounted by a female head. In the occipital region there is a small orifice leading to a larger cavity which, at the time of the discovery, was filled with pellets. These, the discoverer supposed to be pills. This is one of the most beautiful specimens of antique pottery which it has been my fortune to observe. The clay was properly tempered, showing a homogeneous mixture, and the body is of as uniform thickness as though turned on a potter's wheel. The general form is graceful, and the female head is far from being a caricature.

Fig. 20.

Urn from a Mound near Laporte, Indiana. = ½.

Fig. 21.

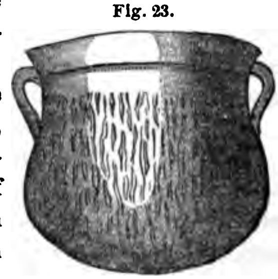
Fig. 22.

Sepulchral Urns from the Mounds near Laporte, Indiana. = ½.

PIPES.—Under this head I give an example (Fig. 19), by way of illustration, for the reason that here we have the human countenance moulded with some degree of artistic skill. In the stone

sculptures, representing this class of implements, we have the highest type of the Mound-builders' art. The narrow, receding forehead, the broad cheek bones, caused by the outward sweep of the zygomatic arches, and the projecting jaws,—characters which appertain to the inferior races—are here represented. This is about the only instance of an obscene figure (the posterior extremities are omitted) which I have observed.

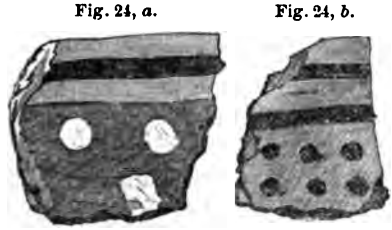
Fig. 23.



Urn from an Ancient Grave. Greenup County, Ky. = ¼.

Sepulchral Urns. — These are quite numerous, and are often graceful in form, and elaborately decorated. Not unfrequently there is found at the bottom of them a dark carbonaceous matter which may be the residuum of the food which they contained when placed at the head of the corpse. I give three illustrations (Figs. 20, 21 and 22) of this class of utensils, taken from the mounds near Laporte, Indiana, by Dr. Higday. In one the material is a finely tempered clay, and the thickness of the walls is so uniform, that I have been led almost to the belief that it was turned on a potter's wheel. The other two are of a coarse texture, and the ornamentation is less skilfully accomplished. The curved lines appear to have been traced by a sharp-pointed instrument, and the indentations to have been punched by a square-pointed one, when the clay was in a plastic state.

Fig. 24, a. Fig. 24, b.



a. Ancient Pottery from Merom, Indiana. b. Ancient Pottery from New Mexico (Prof. Cox's Collection).

The urn, represented in figure 23 is in Professor Cox's Collection, and was taken from an ancient grave near the mouth of Big Sandy River, Greenup County, Kentucky. It differs from the others represented in having handles, and the ornamentation consists of a series of corrugated lines, vertically disposed.

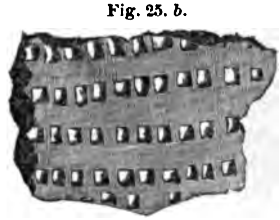
Kettles. — On the borders of the Saline River, Gallatin Co., Illinois, according to the manuscript notes of Professor Cox, Director of the Geological Survey of Indiana, and kindly placed at my disposal, there issues a salt spring which was resorted to in the earliest settlement of the country by those of European de-

scent for the purpose of procuring salt by evaporating the brine. The Indians, according to Cotton Mather and other authorities, never employed salt in curing their meats, but resorted to the process of drying and smoking; yet here occur in abundance, fragments of pottery, showing that a prehistoric people visited this spring for the purpose of "boiling salt." From the slight curvature of the fragments, it is evident that the vessels were of large capacity. The material is coarse; the general thickness of the walls is about half an inch in diameter, but becomes thicker about the rim. The external markings consist of vertical lines of depression, half an inch apart, with lines sometimes horizontal, and at others oblique, so that I am inclined to believe that in moulding these large vessels, they constructed a wicker-work of rushes to sustain the clay until it had become dried.*

It is rare to meet with vessels which are decorated with colors,

Fig. 25, *a*.

Fig. 25. *b*.



a, *b*, Specimens of Pottery from Aztalan, Wisconsin.

yet such relics are found at Merom, Indiana (Fig. 24, *a*), in this respect resembling the pottery collected by Prof. Cox, west of the Rio Grande in New Mexico (Fig. 24, *b*). In both instances the fragments are marked by broad stripes of black around the rim, while the body is ornamented with circular spots; with this difference, however, that in the one instance, the effect is produced by a dark background, while in the other the process is reversed. Professor Cox informs me that the Indians of New Mexico colored their pottery black, by using the gum of the *mezquite*, which has much the appearance and properties of gum arabic, and then baking it, by which the mordant became set. Much of the pottery from the Colorado Chequito is colored, the prevailing tints being white, black and red.†

* Since this article has been in type I have seen a paper by Mr. Charles Rau, in which this pottery is spoken of, and the same views expressed as to its mode of manufacture.

† Vide "Pacific Railroad Reports," Vol iii. Whipple's Report on the Indian Tribes, p. 48.

The pottery found at Aztalan, Wisconsin, is of a coarse texture, and crude in its ornamentation, like that of the European Stone Age.* In the first example (Fig. 25, *a*) the ornamentation is effected probably by a twisted band pressed into the plastic clay; and in the second example (Fig. 25, *b*), by a square-pointed instrument, similar to that used by the Laporte Mound-builders (Fig. 20).

It may be remarked in the nature of a generalization, that in the region of the confluence of the Ohio and the Mississippi as the supposed centre of the Mound-builders' empire, the pottery is composed of much finer-tempered materials, is distinguished by a greater variety of form and outline, and the artistic conception is of a far higher range and fidelity of execution than are to be found in the specimens from what may be regarded as the frontier regions of Wisconsin, Northern Indiana, and Northern Ohio.

I have said in the introduction to this article, that the Mound-builders, in the selection of the materials, and in the moulding of them into artistic forms, were far in advance of the inhabitants of the Bronze Epoch of Europe. The evidence on which that opinion is founded is contained in the illustrations which I have given. While the inhabitants of the European Bronze Age were content, in their artistic delineations, with simply curved lines and chevron-like markings, the Mound-builders adopted not only the bold swell of the scroll-like ornamentation, but grappled with the delineation of the human figure and human face,—the highest perfection of art; and in this range of modelling, it will be admitted, from the examples submitted, that they soared far above mere caricature,—that they imprinted upon the plastic clay the characteristic features of their race.

* Specimen *a* is almost identical in its markings with those on ancient pottery from West Kennet, England (*Vide* Lubbock's "Prehistoric Times," p. 162, fig. 154). Compare this also with specimens of pottery from New Jersey, given by Abbott, fig. 86, in the AMERICAN NATURALIST for April, 1872.

REVIEWS AND BOOK NOTICES.

The Embryology of Fossil Cephalopods.*—This essay contains some of the results of several years' study of the rich collection of fossil Cephalopods contained in the Cambridge museum. The special investigations recorded here were made for the purpose of ascertaining the limits of the embryological period among the typical Ammonites. In order to do this the author made sections of the shell and worked out the form of the embryo or young animal just after being hatched. This may be detected by breaking away the older whorls, and getting at the minute globular sac, which represents the shell in its first stage. This sac may be found in Ammonites and Goniatites, but in the shell of Nautilus it is not retained, though "traces of its former existence are apparent on the apex of the first whorl in the form of a scar or cicatrix. Into this sac opens the first whorl of the shell; other whorls are added, until they form a long series coiled up closely, as in the Ammonites so familiar to geological students." As is well known to palæontologists there are all grades of form from the "straight Orthoceras to the coiled Nautilus, and inversely, among Ammonoids from the closely coiled Goniatites and Ammonites to the straight Baculites; the general morphology being readily and accurately expressed as a coiling up of a straight cone, and the subsequent uncoiling of the same at later stages of the earth's history. The shells are almost universally classified in accordance with this coiling and uncoiling, with which also the structure of the siphon and septa are more or less correlated." Prof. Hyatt has endeavored, and we think with great success, to show that this series of forms is epitomized in the life of the individual Nautilus or Ammonite. The young in these Cephalopods are at first uncoiled like some genera, and the different degrees of coiling up find a permanent expression in the genera of Ammonoids.

He figures the embryos of certain Goniatites, and from the differences presented by them, a succession of forms is detected which accords with what we know of the morphology of these Cephalopods and their geological succession. He concludes that—

* Fossil Cephalopods of the Museum of Comparative Zoology; Embryology. By Alpheus Hyatt. (Bulletin of the Museum of Comparative Zoölogy, Cambridge, Mass., vol. iii, No. 5. Cambridge, 1872. 8vo. pp. 116, with cuts and four lithographic plates.)

"The range of form has been among the Nautiloids from the straight Orthoceratite through intermediate arcuate genera, to the partially coiled Lituites, and finally the closely coiled Nautilus. Such being the case, if there is any truth in the doctrine of evolution, we must expect to find some reference to the peculiarities of the parent Nautiloid stock in the earlier stages of development among the Ammonoids. And further, as a direct and unavoidable corollary of the above, we ought to find this reference more distinct in the young of the earlier species of Ammonoids, the Goniatites of the Silurian, and less noticeable in Goniatites of the Devonian and Carboniferous, and, finally, almost obliterated, or at any rate, still less distinct in the typical Ammonites of the Jura. So far as the facts have been ascertained, they all point in this direction. The simple Nautiloid-like Goniatites of the Silurian may exhibit an Orthoceratitic or straight form, or be closely coiled in the young of different varieties of two distinct species. A species, therefore, on this horizon, may have a range of variation in form, during the earlier stages of development, equivalent to that occurring among the adult forms of Nautiloids from Orthoceras to Lituites. We find in this a perceptible acceleration in the development of the young precisely proportionate to the estrangement, either in time or in adult organization, of the Ammonoids from their supposed parent stock. There are evidently two tendencies at variance with each other: one strongly reversionary, appearing in the frequency with which the earlier Goniatites repeat the parent form in certain isolated instances in the young of varieties, and in the different species of the later Goniatites manifesting itself in the arcuate cone of the young of *Goniatites compressus* and others of the Nautilini, and in the closer, though non-involute, coiling of the young of other forms. Evidently this tendency is losing its power to affect and modify the organization, or, in other words, its prepotency. The other tendency, which is expressed in the closer coiling of the whorls, and finally in their increasing involution, is decidedly progressive, increasing in power to the final and ultimate extinction of all reference to the ancestral type, except in the internal organization. Here, as will be shown, the siphon for a limited time remains central in the first whorl, and the first septum has a large entire abdominal cell, and simply concave lateral lobes, as in the Nautiloids.

The form, however, of the first whorl of the Ammonoid is like Goniatites, the shell similar, and the second septum has the invariable abdominal lobe, superior lateral cells, and lobes of the simpler adult Goniatites, but not by any means of the simplest Goniatites. The simplest adult Goniatites have no proper lateral cells, but only broad lateral simple curves to the septa, as if the first septum of the Ammonite was modified or broken by a small abrupt lobe on the abdominal side. Contrast this with the development of the septa, and their gradual change in *Goniatites com-*

pressus, and we see at once that the development of the same parts is very much quickened or accelerated in the typical Ammonite.

That this acceleration of development is due to the prepotency of the same progressive tendency as the closer and closer coiling, and final involution of the ovisac, by the first whorl, can hardly be doubted. Thus, not only in the whole series of Nautiloids are the forms more or less completely coiled and finally enveloping, but in the young Ammonoids this process is repeated, but only as a reversionary tendency of individuals and species, or at most, perhaps, by the group of Nautili."

Our author finds that all the typical Ammonites may be resolved into natural series. As bearing upon the question of mimetic forms, we may refer to the observation that the above noticed series "contain more or less representative or mimetic forms due to the resemblance occasioned by the amount of the involution or the characteristics which are usually correlative with the amount of involution." He also indicates the effects upon the individual and the group to which it belongs of the changes due to old age, which have not been sufficiently taken into account by observers.

"When, however, the organization of the group no longer progresses, but retrogrades by the uncoiling of the whorls in Scaphites, Ancyloceras and Baculites, repeating—as shown by several authors, but notably by Barrande—the earlier forms of the Nautiloids in inverse order, these, though strictly mimetic, are produced by the encroachment of senile characteristics. These are observed in the old age of such species as *Ammonites Humphriesianus*, where the old whorl becomes smaller, more cylindrical and, if growth was continued, must eventually strike off from the regular spiral as in Crioceras or Lituites. This irregularity is found at earlier and earlier stages of growth, and finally affects the whole form as in the completely straightened Baculites. Direct inheritance of senile characteristics is not claimed, but merely that retrogression of the individual in old age and the retrogression of the group are similar, and both due probably to the same cause, exhaustion of the powers of growth."

As an example of Cope's law of "retardation" in accounting for the origin of distinct forms, Prof. Hyatt cites the case of the spiral or Gasteropod genus Turrilites.

"The young of several species of typical Ammonites often assume the spiral, although this is entirely suppressed at a later stage, and the succeeding whorls resume the normal mode of growth and revolve in the same plane. When, therefore, the normal mode of development is "retarded," we find even in the adult this Turrilites-like condition of the young, which is as truly reversional as the

Orthoceratitic young of *Goniatites fecundus*. This happens occasionally in the lower Jura, and finally, after the progressive stage of the whole order passes its climax, in the lower and middle Jura, we find the development of a whole group affected by this retardation, and the spiral is common to several generic forms."

We believe that the author is on a line of investigation bearing most intimately not only on the origin of organic forms, but also on a question next in importance, the law of their extinction. How an animal or plant is produced is a matter of the greatest interest, but is not the cause of its decay and death one almost as interesting?

Since the present essay was published the author has gone to Germany to study the collections of fossil Cephalopods in the museums of Hanover, Stuttgart, Tubingen, etc. From a recent letter we take the liberty of quoting some remarks which confirm the conclusions of his first paper on this subject,* and of the treatise before us.

He took as a test of the whole order the family of Arietidæ, which are confined to one formation, the lower Lias.

" It is simply wonderful to see how perfectly the geological position of each species in the formations here agrees with its place in the series as determined by development. The successive minor formations of the lower Lias are nothing more than successive faunæ. They are the smallest divisions that it is possible to make in the geological series of rocks, and yet there is no more confusion than results from one species passing by another, or living longer.

Obtusus bed.	*a b*
Angulatus bed.	*a*

Thus *a* may live longer than *b* and appear along-side of it, but the young of *b* is like the adult of *a* always. Now, then, I think we can depend upon development to give us the laws of descent, and not only that but more. In fact I feel sure that I can give the reason why one entire fauna is different from the next, or that which preceded it, and why also the species on the same level have some common characteristics. This is the legitimate

* On the Parallelism between the different Stages of Life in the Individual, and those in the entire group of the Molluscous order Tetrabranchiata (Memoirs of the Boston Society of Natural History Vol. 1. Part 2. 1867). The characteristics of the period of decline of the individual cephalopod shells have been discussed by D'Orbigny. This idea is extended by Hyatt to include the collective life of this order of the class of Cephalopods, during the geological periods in which the order came into existence, culminated, and then declined and went out in forms both reminding us of the embryos of the Nautilus and Ammonite, as well as the earliest generic forms of the order. Thus according to Hyatt's theory the different stages of the life of the individual Nautilus or Ammonites accord with those of the collective life of the entire order.

result of the developmental theory, and must be so, if we can compare the growth of an individual to the progressive existence of a species or a group in time. To do this, however, my old age theory becomes almost as important as development itself, or else the entire period of decline in the different groups and series, and many characteristics of their early beginnings, as well as the resemblances which exist between the forms at the beginnings and at the ends cannot be accounted for. In fact I am now sure that the proportions between the different periods of the life of any one individual may be compared with accuracy to the life of the group to which it belongs; in youth to what the group is in the beginning, in the adult to what it is now, and in old age to what it is to be in the future."

Another point of interest that engaged the author's attention was the discovery of the ancestral form of the Tetrabranchiate Cephalopods. Such a form he is disposed to think occurs in Endoceras. Giving his reasons in full he concludes that "it is in this group, therefore, or in some closely associated genus, that we must look for the ancestors of the Tetrabranchiate Cephalopods." The genus is a subdivision of Orthoceras (belonging to the group Vaginati), a straight-shelled Cephalopod figured in all the text-books. Barrande's opinion is also cited. That distinguished palæontologist has also "settled upon Ascoceras as the prototype, regarding the Vaginati as the nearest allies of Ascoceras."

We may safely say that this is one of the most thorough palæontological essays that have appeared for many a day. The author seems to have had unusual facilities for study, as he acknowledges his indebtedness to the liberal views pervading the management of the museum by which he was allowed to break up valuable specimens in the course of his investigations. The four lithographic plates illustrating the present Bulletin are exquisite.

Life Histories of our Butterflies and Moths.* — These are carefully elaborated accounts of the metamorphoses of some of our common moths (*Sesia diffinis*, *S. Buffaloënsis*, *Thyreus Abbotii*, *Philampelus Achemon*, *Smerinthus geminatus*, *Daremma undulosa*, *Platarctia Parthenos*, *Euprepia Americana*, *Euchætes egle*, *Lagoa crispata*, *Hyperchiria Io*, *Eacles imperialis*, and *Anisota senatoria*) which in some cases were raised from the egg. We find many

* Entomological Contributions, No. II. By J. A. Lintner. From the twenty-fourth Annual Report on the New York State Museum of Natural History, for the year 1870. 8vo. pp. 66.

remarks on the habits of these insects, their mode of constructing their cocoons and the food plants of the caterpillars. The author describes quite fully two sexes of the larva of *Thyreus Abbotii*, which is "peculiarly interesting from the fact that its two styles of ornamentation, in marked contrast one with the other, indicate the sex of the insect, no other instance of which among the Lepidoptera is known to us. The dorsal and lateral series of spots, yellow as described above, but frequently and perhaps usually of a pale green color, denote the male; the female being brown, without any trace of the above spots, but with interrupted, dark, subdorsal and stigmatal bands and numerous small longitudinal patches." The remarks on the varieties of *Smerinthus geminatus* Say will attract the attention of entomologists, since the author found among some moths of this species, "a female, having but a single blue pupil on the black ocellated spot of the secondaries. The occurrence of this variety is peculiarly interesting from the fact that upon specimens differing from the type of *S. geminatus* mainly in having but a single pupil, two other species seemed to be based, viz., *Sphinx ocellatus Jamaicensis* of Drury and *Smerinthus Cerisyi* of Kirby. . . A careful comparison of Drury's figure with our variety leaves scarcely a doubt of their identity." Other specimens show "quite an approach" to *S. Cerisyi*, which Mr. Lintner thinks "is, in all probability, a simple variety of *S. geminatus*." We are glad to see that the specific name Io is restored to what Walker called *Hyperchiria varia*. The reviewer acknowledges the correctness of Dr. Speyer's decision. The author advocates the rearing of caterpillars upon growing plants, which is becoming a favorite method with lepidopterists. In conclusion, we must confess ourselves greatly pleased with this brochure as it considerably advances our knowledge of the lives of our butterflies and moths.

As we are going to press with this notice, the first series of "Entomological Contributions" comes to hand. It is replete with new and interesting details concerning the life of our butterflies and moths. The history of *Hemileuca Maia* occupies twenty pages. We have also elaborate descriptions of the early stages of *Melitœa Phaeton*, *M. Nyceteis*, and *Pieris oleracea* and descriptions of three new species of Nisoniades, and a new Ellema. The other notes of times of capture, etc., are of practical importance.

Collectors will find some useful hints regarding field work. We quote the following passage: —

"Mr. Meske's field collections are made with unusual care. A gauze net is used by him, of so delicate a texture that the captured insect, in its efforts to escape, may brush against its sides without the loss of any of its cilia. As quickly as possible it is withdrawn from the net in a wide-mouthed bottle, and speedily quieted by a few drops of chloroform, poured on some cotton contained in a glass tube passing through the cork. When the insect is dead, or nearly so, it is carefully turned out on the palm of the left hand, and in that position pinned, without taking it as is usually done between the fingers.

I have found a lump of cyanide of potassa, secured by a piece of gauze to the stopple of a bottle (a French mustard jar with its hollow screw stopple forms an excellent collecting bottle), to be more convenient for use than chloroform, and nearly as prompt in its effects."

We are quite well satisfied with the use of cyanide of potassa.

A Hand-book of British Fungi.*—The increasing interest in the study of the Fungi, especially their microscopic forms, leads to the frequent inquiry for some compact and trustworthy manual of this somewhat puzzling class of plants. Mr. Cooke is well known as an enthusiastic and experienced author on the subject, and this treatise is the best which the English or American student can employ to assist him in his home researches. References to United States habitats are largely given, and the measurements and descriptions by Greville, Fries, Berkeley, Smith, etc., added to Mr. Cooke's own observations on almost every species. In classification, the author has endeavored to simplify the arrangement, as much as the great influx of new discoveries would permit. To have succeeded, however imperfectly in this, is to have earned the gratitude of every student of the Fungi—for no branch of botany has been in greater confusion and embarrassment of nomenclature. The extremely plastic character of fungus life is perhaps an excuse for this, but Mr. Cooke seems to have taken hold of the difficulty with courage and to have worked with decided views of his own, which it is to be regretted that the proposed limits of the volumes left him no room to explain at length. The references are very full, much more so than the size of the work would prom-

* Hand-book of British Fungi, with full Description of all the Species, and Illustrations of the Genera. By M. C. Cooke, M.A., London and New York: Macmillan and Co. 8vo, 2 vols., pp. 982. Price $12.

ise. The spore measurements, a delicate but necessary matter, have been well done. It may be added, that since the appearance of this work Mr. Cooke, in company with Mr. C. H. Peck of Albany, New York, has been engaged in the study of the Erysiphei of the United States, and has already published several papers which might well accompany the hand-book to the study table of any American botanist.—E. C. B.

BOTANY.

SECOND GROWTHS IN TREES.—A matter which has not received the attention which perhaps it deserves is the growth of trees twice or more during the same season. Some, like the horse chestnut, make but a single growth, when the upper leaves are reduced to perfect bud scales; and although there is, probably, a growth of the embryonic parts of the next year's leaves and flowers beneath these scales for sometime afterwards, to all appearance growth ceases for the season. Others, as in the Norway and sycamore maples, gradually decrease in the size of their leaves as midsummer approaches; the internodes occupy less and less space, but before finally taking on the condition of a terminal bud a new growth commences, the leaves grow larger, and before the final fall resting comes, they have nearly reached the size of those of the early summer time. The English oak almost always makes two of these growths, and sometimes three, and this is also the case with *Pinus mitis*, *P. Banksiana*, *P. inops*, *P. pungens*, and sometimes but not so frequently in *P. rigida* and *P. Tæda*. I think it likely that in most trees which make a continuous growth through the summer season there is more or less of this growth rest, and successive reaction. In the apple tree, and the Carolina and cottonwood poplars, this approach to rest about midsummer is very plainly seen by a shortening of the internodes; after this they again widen, and in the case of these two, the leaves of the second growth are much larger and more vigorous in every respect than those of the first cycle or wave of growth. I have often set myself to the study of the causes of this varying growth force, without feeling satisfied that I could comprehend them clearly. In some way it would seem to be dependent on the powers of nutrition, as in the apple and many other trees it is only the most vigorous shoots which make a re-

newed start; but on the other hand I have seen two trees of English oak side by side together for about twenty years, one making mostly three of these growth cycles, and the other but two, and yet up to this time neither of these has gained any advantage in size over the other. Again, in the case of the horse chestnut, if the leaves be picked off before the terminal bud is quite mature, it will make another growth the same season. In like manner if the leaves of most trees be taken off before the cycle of growth has been quite completed, most of the axillary buds, which otherwise would have remained dormant till the next year, will at once push into growth. If the leaves have to aid in the *immediate* nutrition of the axis with which they are connected, which I am sometimes led half to doubt, the check to nutrition by their loss seems rather to aid more than full nutrition does in the secondary axial development. It is however certain that it is the most vigorous growths on any tree, or the most vigorous individuals, or even varieties, which make these repeated cycles. The common European ash rarely makes a second growth unless in a very vigorous condition. The variety *heterophylla*, which makes a longer, and a stouter growth, usually makes two; but another variety, known in gardens as *Fraxinus excelsior jaspidea*, which has stouter branchlets than either, generally makes three growths.

It would be very interesting to know exactly the relation between nutrition and accelerated growth as exhibited in these successional waves. I have, in papers no doubt familiar to many of your readers, shown how varying powers of nutrition modify the form of leaves, and in other cases even regulate the production of the sexes; and it is by no means improbable that the same laws will be found operative in the production of species itself; for frequently specific, perhaps one might say generic, differences are no greater, than are sometimes found in the varying growths on the same tree, or the differences between one sex and another. This is a well known fact, as genera of both plants and animals have not unfrequently been founded on specimens which were in time found to be but another sex of the same thing.

A knowledge of these successive annual growths may aid our friends in systematic botany. As Mr. Gilman points out, in the AMERICAN NATURALIST Vol. vi, p. 684, in his note on the gray pine, Dr. Engelman divides our American pines according as the female flower is lateral or terminal. But really all these pines are

terminal,—that is to say the flowers terminate one or the other of these growth cycles. If the shoot makes but one of these efforts, the flower remains terminal; but if after forming these buds, it "concludes" to go on again with another growth, the flower is of necessity pushed aside, and then the cone becomes lateral. In other words, there is no such thing in Pinus as a lateral cone when there is but a single cycle of annual growth, and therefore the division of Dr. Engelman is founded on an accidental rather than an organic difference. I think however that what are known as the terminal flowered group never make a second growth, and therefore Dr. Engelman's division is excellent, only changing the description into "Pines which never make a second growth" and "Pines which generally do." The gray pine can then stay where it is without the creation of an intermediate group as suggested by Mr. Gilman.

In the suggestions I have made here, there is nothing new. They have appeared at various times during the past six years in the "Proceedings of the Academy of Natural Sciences of Philadelphia;" but I suppose the mission of the NATURALIST is to extend knowledge, as well as to record the discovery of new facts.—THOMAS MEEHAN.

ZOOLOGY.

THE SLAUGHTER OF THE BUFFALO.—The destruction of this noble beast was carried on during the past year with a rapidity entirely unprecedented, although it has been a matter of regretful comment for years. I have authority for the assertion that one firm in Leavenworth received thirty thousand hides per month, while two others in Kansas City received fifteen thousand each in the same time. This is at the rate of two thousand slain per day. The immense piles or stacks of hides, to be seen at all the stations along the line of the Kansas Pacific railroad, bear witness to the slaughter. Prof. Mudge of Manhattan, Kansas, who is well informed as to the economy of the plains, places the number killed at one thousand, a number sufficiently high to insure the early extinction of the species.

It is to be greatly hoped that Congress will early take action for the preservation of a reduced herd of buffalo, in a reservation set apart for the purpose, or enact protective laws. Such might impose penalties on persons found in possession of any part of

the animal during certain months, a sufficient time being allowed for their increase. At present, this finest of our wild animals ranges over territory which will long remain unsettled, owing to its want of water. While the river bottoms of Kansas, Nebraska, Colorado, etc., will soon be taken up, the high plains of those regions will be utterly void, unless occupied by nature's tenants, the buffalo, prong-horn, elk, etc. Artesian wells for irrigating these tracts are still in the far future.

The government of China has preserved several species of animals from extinction in the imperial parks and preserves. The Czar of Russia has protected the European bison from destruction in the old forests of Lithuania. Our own government preserves the beauties of the inanimate creation in the Yellowstone park. How much more should it keep for the instruction of future generations a full representation of those higher works of creative mind, the living beings that characterize our continent.—E. D. C.

A PARTIAL COMPARISON OF THE CONCHOLOGICAL FAUNÆ OF PORTIONS OF THE ATLANTIC AND PACIFIC COASTS OF NORTH AMERICA. —A distinguishing feature in the conchological fauna of that portion of the Pacific coast included between the Straits of Fuca and San Diego, and which is called the Californian and Oregonian Zoological Province, when compared with the Atlantic coast of North America, from the Arctic seas to Georgia, is the preponderance in the former province over the latter of those forms of molluscan life included in the order Scutibranchiata.

The total number of marine molluscan species and well-marked varieties, so far as known and determined, in the Californian and Oregonian Province, is in round numbers 630, of which about 200 are bivalves, and of the remaining 430, 123 are included within certain Scutibranchiate families. Of this 123, no less than 40 belong to the Chitonidæ and as many more to the Trochidæ.

Of the 247 marine gasteropods enumerated by the late Dr. Stimpson in the Smithsonian Institution check-list, from the Arctic seas to Georgia, 32 only, or less than one-eighth, come within the order referred to; of this number, 14 belong to the Trochidæ, 7 to the Chitonidæ, and not a single specimen of Haliotis has been found as yet within the limits named, and only a single individual of very small size has as yet been reported from any point on the Atlantic coasts of the two Americas, and the solitary specimen

referred to was dredged by Count Pourtales in the Florida Gulf Stream a few years ago. When the shells of Florida are sufficiently investigated, so that a check-list may be made, it may somewhat affect this comparison, but other Scutibranchiate species may be found on this coast, so that it is highly probable that the above comparison will remain substantially correct.—R. E. C. STEARNS.

COLLURIO LUDOVICIANUS.— A male in fine plumage, now in my possession, was shot in West Newton, Mass., Oct. 21, 1872, by Mr. Joseph S. Maynard. Allowing the existence of two varieties, if not species, I think this specimen approaches nearer to *Ludovicianus* than *excubitoroides*. Is not this the first recorded instance of the authentic occurrence of this southern and western bird in the coast states, or at least near the coast, north of Virginia if not the Carolinas?—H. A. PURDIE, *November*, 1872.

RACCOON FOX.—In the June number of the AMERICAN NATURALIST (page 362), I find a notice that one of these little animals had been killed, and another seen in Fairfax County, Ohio, and it is remarked, in connection with its northern locality, that the specimen obtained was furred instead of haired. The range of the *Bassaris astuta* is much greater than your correspondent supposes, unless there be two varieties or two species of this genus. They are found, I believe, throughout California, as far north as the Klamath River, Lat. 41° N., where, in 1852, I purchased from an Indian a breech clout made of seven skins, the fur of which was very soft and beautiful. I heard at the time that the "Raccoon Fox," as the miners called it, had occasionally been tamed and employed to destroy mice and other vermin. In Cooper and Suckley's Natural History of Washington Territory, etc., p. 114, your correspondent will find a reference on my authority to the above *habitat*. I doubt if it extends into Oregon, as the Siskiyou Mountains, parallel of 42° N., form a geographical boundary for several species of animals, birds and plants.

The specimens in question were probably escapes, brought either from Kansas or California by some returned miner or emigrant.—GEORGE GIBBS, *New Haven*.

GEOLOGY.

ON A NEW SUB-CLASS OF FOSSIL BIRDS (ODONTORNITHES).—The remarkable extinct birds with biconcave vertebræ (*Ichthyornidæ*),

recently described by the writer from the upper Cretaceous shale of Kansas,* prove on further investigation to possess some additional characters, which separate them still more widely from all known recent and fossil forms. The type species of this group, *Ichthyornis dispar* Marsh, has well developed *teeth in both jaws.* These teeth are quite numerous, and implanted in distinct sockets. They are small, compressed and pointed, and all of those preserved are similar. Those in the lower jaws number about twenty in each ramus, and are all more or less inclined backward. The series extends over the entire upper margin of the dentary bone, the front tooth being very near the extremity. The maxillary teeth appear to have been equally numerous, and essentially the same as those in the mandible.

The skull is of moderate size, and the eyes placed well forward. The lower jaws are long and slender, and the rami are not closely united at the symphysis. They are abruptly truncated just behind the articulation for the quadrate. This extremity, and especially its articulation, is very similar to that in some recent aquatic birds. The jaws were apparently not encased in a horny sheath.

The scapular arch, and the bones of the wings and legs, all conform closely to the true ornithic type. The sternum has a prominent keel, and elongated grooves for the expanded coracoids. The wings are large in proportion to the legs, and the humerus has an extended radial crest. The metacarpals are united, as in ordinary birds. The bones of the posterior extremities resemble those in swimming birds. The vertebræ are all biconcave, the concavities at each end of the centra being distinct, and nearly alike. Whether the tail was elongated cannot at present be determined, but the last vertebra of the sacrum is unusually large.

This bird was fully adult, and about as large as a pigeon. With the exception of the skull, the bones do not appear to have been pneumatic, although most of them are hollow. The species was carnivorous and probably aquatic.

When the remains of this species were first described, the portions of lower jaws found with them were regarded by the writer as Reptilian; the possibility of their forming part of the same skeleton, although considered at the time, was not deemed sufficiently strong to be placed on record. On subsequently removing the surrounding shale, the skull and additional portions of both

* American Journal Science Arts, vol. iv, p. 344, Oct. 1872, and vol. v, p. 74, Jan., 1873.

jaws were brought to light, so that there cannot now be a reasonable doubt that all are parts of the same bird. The possession of teeth and biconcave vertebræ, although the rest of the skeleton is entirely avian in type, obviously implies that these remains cannot be placed in the present groups of birds, and hence a new subclass, *Odontornithes*, is proposed for them. The order may be called *Ichthyornithes*.

The species lately described by the writer as *Ichthyornis celer*, also had biconcave vertebræ, and probably teeth. It proves to be generically distinct from the type species of this group, and hence may be named *Apatornis celer* Marsh. It was about the same size as *Ichthyornis dispar*, but of more slender proportions. The geological horizon of both species is essentially the same. The only remains of them at present known are in the museum of Yale College.

The fortunate discovery of these interesting fossils is an important gain to palæontology, and does much to break down the old distinctions between birds and reptiles, which the Archæopteryx has so materially diminished. It is quite probable that that bird, likewise, had teeth and biconcave vertebræ, with its free metacarpals and elongated tail. — O. C. MARSH, *reprinted from advance sheets of the American Journal of Science and Arts for February*, 1873.

ANTHROPOLOGY.

CHANGE IN THE FORM OF SKULLS WITH AGE.—The hypothesis, at one time so universally held, says Virchow, that all longheaded skulls were Celtic, may now be taken as an example of how easy it is to overstep the mark, and of the caution that should be exercised in anthropological inquiries. Any conclusions that may be drawn from the forms of skulls of early times are quite open to question. The influence of culture has hitherto been too little considered. Schaffhausen has observed that the growth of the skull continues to a later period than was formerly supposed, and that it increases in breadth in old age. This explains how it happens that so many more of the long and narrow skulls have been traced to earlier times, and that the proportion of the broader ones increases in the quaternary epoch. In the case of the broad skulls the brain has usually attained fuller development, while the most remarkable long and narrow skulls are to be met with among

lower races. For this reason, then, peculiarities of races become obliterated in time. — *The Academy.*

MICROSCOPY.

A FIELD-STAGE FOR CLINICAL MICROSCOPES.—Dr. R. H. Ward called attention at the Dubuque meeting of the American Association, to a contrivance by which he is able to employ in field work the ordinary form of clinical microscopes. Such microscopes are but little available for opaque objects, the small opening sometimes made through the tube just above the stage being objectionable in respect to focussing and being nearly useless for illuminating purposes by ordinary daylight. The new field-stage is a perforated brass stage-plate occupying the position of the object and bearing a contrivance by which the object is carried at the distance of about an inch lower down. In the instrument shown to the Association, which was home-made and could be made by any one in a few moments, a heavy brass wire was carried down from the brass stage-plate, bent so as to form a rectangular frame on which the object-slide or compressor could rest, and then bent back to the stage-plate again. It was attached to the stage-plate by being bent at right angles and soldered along the sides of the plate to its under surface. The object was held upon this accessory stage by slender wire springs also soldered fast. With this new stage the clinical microscope becomes available for low powers and opaque objects.

PIGOTT'S "SEARCHER" IN THE BINOCULAR.—Dr. John Barker exhibited to the Dublin microscopical club a one-inch objective employed as a "searcher," as suggested by Dr. Pigott. His object was to propose its application to the binocular microscope by inserting a one-inch objective in each body, and thus attain in connection with stereoscopic vision, the high amplifying power of such arrangements.

UNDER-CORRECTED OBJECTIVES.—Objectives considerably under-corrected as to color are now furnished by a variety of leading makers and are generally preferred by critical microscopists. They not only work better for photography and with monochromatic illumination, but they excel for ordinary work those lenses in which the corrections for spherical aberration are sacrificed for the sake of a more perfect achromatism. Powell and Lealand, Tolles

and Gundlach are prominent examples of those makers who seem to have adopted this policy of under-correction for color.

Microscopy in New Jersey.—Mr. E. Gundlach, the celebrated proprietor of the Optical Institute at Charlottenburg, Prussia, has removed his residence to this country. He is now living at Hackensack, New Jersey, where he proposes to devote his attention exclusively to the manufacture of first-class objectives.

Determination of Powers in the Compound Microscope.—This subject was discussed at a meeting of the Queckett club, and a variety of appliances recommended for the purpose. The simplest plan, and one familiarly employed by many microscopists, was advised by Mr. S. J. McIntyre who ascertained the apparent size of the field of view, and reduced it to thousandths of an inch, and divided that number by the number of divisions of a stage micrometer (ruled to thousandths of an inch), included in the field of view. Thus if the apparent field of view with a certain ocular is five inches ($\frac{5000}{1000}$) and with a certain objective it includes twenty-five divisions of a stage micrometer ruled to thousandths, then the power of the microscope as thus arranged will be $\frac{5000}{25}=200$. With another objective it may include four divisions, and the power will be $\frac{5000}{4}=1250$. This plan is sufficiently accurate for practical purposes, and is, on the whole, the easiest method in use.

Sections of Insects.—Mr. Henry N. Moseley advises to harden the insects by immersion for about a week in absolute alcohol. They are then, or any time afterward, to be embedded in a mixture of sweet oil and wax of suitable hardness, which he prefers to paraffin, and sections are to be cut with a sharp, thin edged razor wetted with absolute alcohol. The sections are to be immediately floated off on to slides, stained with carmine, treated with absolute alcohol and then with oil of cloves, and mounted in Canada balsam or dammar varnish in the usual manner. Extremely beautiful specimens are thus prepared, showing the general anatomy of the insect. Instructive objects are obtained by sections passing through the eyes, especially if carried at the same time through the cephalic ganglia. The eyes of the mollusca, leeches, etc., may be similarly prepared.

Staining Tissues.—Dr. R. L. Maddox has been studying the

tissues of the frog's tadpole's tail, with special reference to the distribution of the nerves, and relates his method of preparing the tissues in the "Monthly Microscopical Journal." Beautiful results were obtained by placing the tadpoles for about five minutes in a mixture of three drams of chromic acid solution (one-fourth per cent.) and twenty drops of sweet spirits of nitre; then washing repeatedly in pure water, immersing for about three minutes in ammoniated water (four drops strong liquor ammonica to three drams of water), washing off the epithelium in pure water with a camel's hair pencil and rewashing repeatedly in pure water; then staining for about five minutes in tincture of logwood diluted with pure water to a sherry color, or in a purple aniline solution, and finally mounted in a nearly saturated solution of acetate of potash slightly acidulated with acetic acid. After staining with logwood an improved result was obtained by washing in the usual iron developer with acetic acid employed for developing photographic negatives. Glycerine was tried as the mounting medium, but seemed inferior to the acetate of potash.

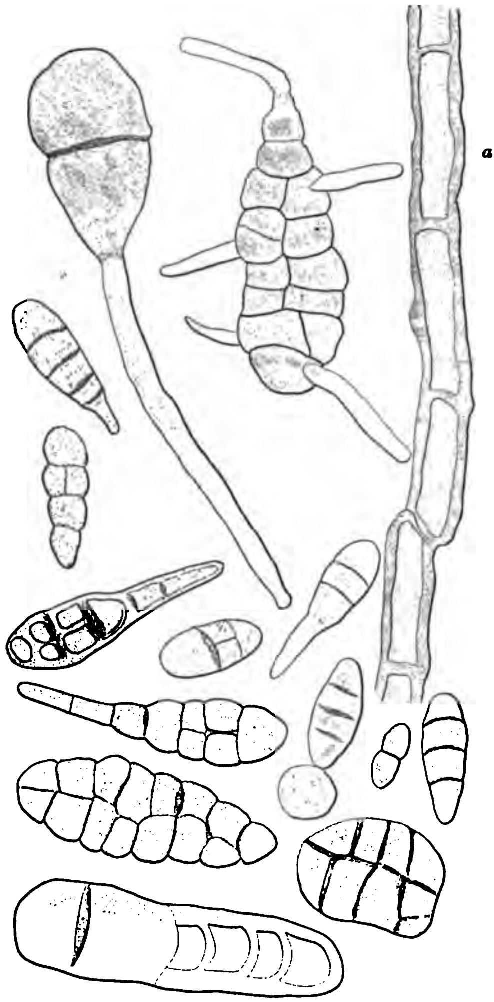
PREPARING PALATES OF MOLLUSKS.—The plan of preparing these palates by boiling in *liquor potassæ*, instead of by dissection, proposed by Mr. Hennah and published eight years ago in the "Intellectual Observer" has recently been inadvertently claimed as a novel American idea.

MOUNTING ENTOMOSTRACA.—Mr. O. S. Westcott, after experimenting with various substances, has concluded that a carbolic acid solution, exceedingly dilute is the best mounting medium for the preservation of these minute animals.

THE HORSE DISEASE.—I have recently made a series of microscopical examinations of the matter from the nostril of a horse suffering with the epizootic influenza now so generally prevailing. A power of seven hundred, with Beck's $\frac{1}{5}$ inch objective, was used in making the observations, and in preparing the accompanying drawings. The great mass of the discharge consisted of mucous and pus corpuscles, with many epithelial cells: but I find therein the spores of three species of cryptogamous plants. The spores are all of a brown color, and occur to the extent of thousands in a single drop. One kind, figure 26, are supposed to be spores of *Urceolaria scruposa* a species of lichen: these were in every stage of development, there being hundreds of the fragments of the stem

(Fig. 26, *a*), in a drop. The second kind (Fig. 27) were echinulate spores, probably of some species of *Aspergillus;* and they, as well as the others, gave evidence of propagation and growth.

Fig. 26.

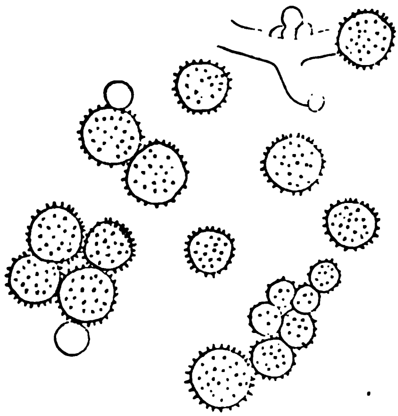


× 700.

The third kind (Fig. 29) were smooth, globular spores, species unknown. A few confervoid filaments (Fig. 28) were present; and also some other organized forms, but not in sufficient number

to be worthy of remark. Sometimes one of the spores divides into several cells and sends forth a shoot from each division, a

Fig. 27.



× 700.

number of sprouts being seen growing from one spore in different directions, giving visible evidence of vegetal growth taking place.

Fig. 28.

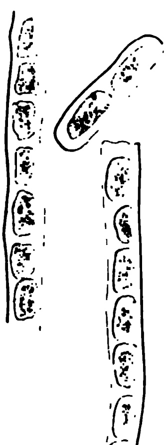
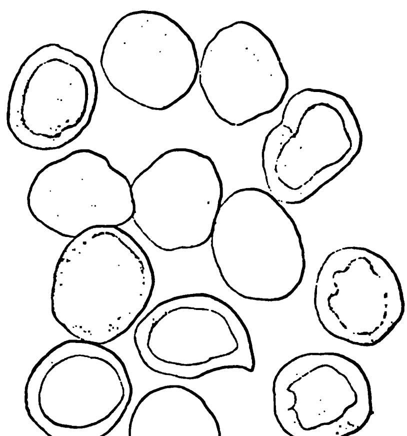


Fig. 29.



× 700.

To ascertain if these organisms were also present in the air, I exposed some clear glass slides to the external air for a few days,

and on examination with the microscope had the satisfaction of finding many of them. It seems to be proved then that the spores are floating freely in the atmosphere, and are inhaled into the air passages. The heat of the animal and the moisture of the mucous surfaces favor their germination and growth; and it seems to me possible that the epidemic catarrhal horse disease, and similar difficulties of man, may be caused by these vegetating spores, the greater or less prevalence of this class of diseases being governed by the relative numbers of the germs in air at different seasons, some seasons being more favorable to their development than others.—G. W. MOREHOUSE, *Wayland, New York.*

ORGANISMS IN CHICAGO DRINKING WATER.—Mr. H. H. Babcock discusses this subject in a paper read at the Dubuque meeting of the American Association. His former suspicions are confirmed, that these forms are not at home in the southern end of the Lake, but are brought down from the north by a surface current along the western side of the Lake. The existence of such a current he finds further proved by the vegetation upon the shores, as he observed at least eleven species of plants established in isolated and evidently accidental positions on the shores near or below Chicago, but which belong at the northern end of the Lake or in the region of the sources of its water.

PINE POLLEN IN LAKE MICHIGAN.—At the Dubuque meeting of the American Association, Dr. R. H. Ward made a report on a specimen of viscid-looking water from Lake Michigan, near Racine. The water of the lake was similarly thickened for miles and was generally believed by the neighboring residents to be of an infusorial character. It contained no infusoria worth speaking of; but was almost filled with pine pollen which was interesting from its enormous quantity, and from the fact that its source could not have been near by, but must have been in the pine forests far to the north, the pollen being brought down by the southerly current along the western shore of the Lake.

NOTES.

AT a meeting of the California Academy of Sciences held October 7, 1872, Mr. W. H. Dall presented a portion of the husk and inner shell of a cocoanut picked up on the north side of the Island

of Oonalashka, especially interesting as showing the direction of the ocean currents in that region.

Capt. C. M. Scammon, U. S. R. M., submitted a description of a new species of whale, *Balænoptera Davidsoni*, the geographical range of which is from Mexico to Behring Straits; the specimen from which the description was made was taken in Admiralty Inlet, Washington Territory. It was a female twenty-seven feet in length and contained a fœtus five feet long, thus correcting a prevalent error among the whalers who have generally regarded this small species as the young of the "finback" of the coast; this animal and its habits will be fully described in the volume now being printed on the "Cetaceans and other Marine Mammals" by Capt. Scammon.

Prof. George Davidson read a paper entitled "Suggestion of a Cosmical Cause for the great Climatic Changes upon the Earth."

"Disliking theories and hypotheses, I must characterize as a suggestion what I have to state upon this subject.

So far as I am aware, geologists have failed to indicate any reasonable or rational existence of a cause for the subtropical fossil flora and fauna found within the Arctic Circle, and for the great ice-sheet—the universal glacier—which doubtless covered nearly the whole land from the poles toward the tropics at a comparatively recent period. To mention is to condemn the extravagant hypothesis of the changing of the direction of the earth's axis, as it involves changes in the gyration of the earth necessarily of greater relative amount than the motions of a boy's top. Partial upheavals and great changes of the surface of the earth are insufficient to account for the phenomena.

The palæontologist has roughly indicated by his zones of fossil floras and fossil faunas that the pole of the earth has not changed its direction, and the astronomer utterly rejects such a change.

My suggestion is that we must look to a cosmical cause for these phenomena; and that cause is in the material or materials burning upon the surface of the sun.

The spectroscope has made known to us the connection between sudden outbursts or storms upon the sun's surface, and the exhibition of magnetic or electrical phenomena on the sun. There has been established a correspondence between the eleven year period of the solar spots and certain other magnetic phenomena. This instrument has revealed to us a sun wherein a sudden outburst of

luminous hydrogen has increased the brilliancy of a star from the ninth to the second magnitude, and its comparatively slow return to its former condition.

It appears to me that herein we strike the key-note of the causes at work to solve our problem of short or long periods of varying climate upon the earth. If the above phenomenon is possible in one sun, it is possible in every one of the millions of millions of suns around us; and of course in ours. That such an eruption of burning hydrogen affects the planets revolving around that sun, we can not for one instant doubt. To our instruments it was an exhibition of force lasting but a few months, and its effect upon probable planets around that sun we can never know. Doubtless all new stars that have suddenly appeared with great brilliancy were the exhibitions of similar forces. If such forces are possible for short periods, they are possible, and to my mind more probable, for comparatively long periods. In our sun the forces are apparently evolved in irregular, and also in moderately regular periods or cycles, and must have an influence upon the general climate of the earth and of the other planets. Even in this year of exceptional heat over the earth, we have the results of the spectroscope, revealing an unusual development of incandescent magnesium over the sun's surface.

If these forces of the sun exhibit themselves in short and long periods, we can comprehend how periods of almost universal flood, of earthquake and volcanic action, of a climate to develop a sub-tropical fauna and flora, even within the Arctic Circle; of a great ice-sheet spreading from each pole, over the land, toward and even embracing the Equator, may be not only probable, but place the latter two in full accord with the astronomical dictum, that no violent change of the direction of the earth's axis is admissible.

The spectroscope is the present means of gathering observations to test my suggestion, or to develop the law underlying these changes; and as we observe the exhibitions of the forces upon the surface of our sun, and note the effect upon the earth, we can also watch the changes upon Mars and the other near planets. But we cannot hope to determine the law of connection within a short time, unless some wonderful event happened in our sun similar to the sudden outburst of luminous hydrogen in the star in the Northern Crown, to show us in an hour the effect such great cosmical changes have upon the earth and other planets of our

system; or unless other instrumental means far beyond the capacity of the spectroscope be devised to show minute connections between changes on the sun's surface and limited periods of phenomena on the earth, such as years of great heat, and earthquake and volcanic activity, perhaps even years of pestilence. A long cycle of years may be required to demonstrate whether a law lies at the base of my suggestion.

Like the observers who make their measures to determine the gradual elevation or subsidence of continental shores, we may not learn the result, but we can aggregate observations for discussion by the next generation."

Mr. W. H. Dall submitted descriptions of new species of shells from the northwest coast of America with notes on species previously described; this paper includes a description of a new species of Voluta of the group Scaphella, particularly interesting as being the first of this family from so high a northern station (Shumagin Island) though allied forms have long since been reported from the Straits of Magellan. To this species, which is of large size, being over four inches in length, Mr. Dall has given the name of *Voluta Stearnsii*. *Buccinum Kennicottii* Dall, described in one of the latter numbers of the "American Journal of Conchology," proves to be a Chrysodomus. A new species of Littorina is also described in this paper as *L. Aleutica* Dall.

Professor Davidson called the attention of the Academy to the earthquake waves recorded by the tidal gauges on this coast on the 23d to 27th of August and on the 16th to 17th of September last. He demonstrated by deductions from the relative rapidity and heights of the waves at different points, that the main shock of the first must have been near the northern coast of the island of Yesso, Japan, and that the latter had originated not far distant in the ocean from the points of observation.

Mr. Stearns read a paper pointing out the predominance, in the Californian and Vancouver zoological provinces, of mollusks included in the Order Scutibranchiata (*Vide* Adams' Genera) as compared with the Atlantic coast of America from the Arctic seas to Georgia.

H.M.S. "Challenger" corvette, of 2306 tons, Commander G. S. Nares, has been despatched by the Admiralty on a circumnavigation of the globe, for the purpose of dredging, sounding, and

otherwise scientifically investigating the deep sea. The scientific staff consists of Prof. Wyville Thompson, Director; Mr. J. J. Wild, of Zurich, artist and private secretary; Mr. J. Y. Buchanan, chemist; Mr. H. N. Mosely, Mr. John Murray, and Dr. von Willemoes Suhm, of Munich, naturalists. The expedition is expected to return in April 1876. They will visit Madeira, Canaries, Porto Rico, New York, Azores, Cape de Verde, Fernando de Noronha, Bahia, Cape of Good Hope, Prince Edward's Isle, Crozets, Kerguelen's Land, Melbourne, and possibly sail round New Zealand, thence round North Australia, follow Wallace's line up to the Philippines, touch New Guinea, Japan, Kamtschatka, Behring's Straits, Vancouver's Island to Varparaiso; thence through the Straits of Magellan to Rio, and so home. Though no botanist is attached to the staff, it is understood that Mr. Mosely will collect plants on every possible occasion.

THE immediate value of geological surveys is again shown in the prompt detection of the recent diamond fraud. Mr. Clarence King, the U. S. Geologist, and his assistant Mr. J. T. Gardiner, visited Bishop Mountain and finding diamonds and rubies there that had been scattered over the soil by another hand than Nature's, exposed a gigantic and disgraceful swindle. The New York "Nation" makes some timely remarks on the value of the unbiassed opinions and observations of a national geologist. Certainly by the exposure of this fraud, the government survey of the public lands has more than paid for all the funds appropriated by Congress, and justifies the conclusion that the largest liberality in scientific enterprises is the truest economy—in short, science pays.

PROF. F. V. HAYDEN is desirous of securing by exchange or purchase, the publications of our own as well as foreign countries on Geology, Palæontology, and Natural History generally, to aid in the formation of a library of reference, for the use of the survey of which he has charge. The reports of surveys, with maps, charts, and sections, transactions of societies, or the publications of individuals engaged in scientific studies, are much desired as works of reference. Parties who may look favorably upon the above proposition can send all packages, through the Smithsonian Institution, to the address of Dr. F. V. HAYDEN, U. S. Geologist, Washington, D. C.

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CONTROLLING SEX IN BUTTERFLIES.

BY MRS. MARY TREAT.

THAT sex can be controlled in butterflies, I think I have demonstrated by careful experiment the past season. Accident first prompted the experiment. Two years ago this past summer, I was feeding a few larvæ of *Papilio Asterias* for the cabinet, when one of my specimens wandered from its food, and rested upon a book to undergo its transformations. Not feeling inclined to give up the book to this purpose, I placed the larva on a fresh stem of caraway; upon removing it from the book, I found its feet were entangled in silk, and that it was in position for a chrysalis, but not yet fastened; so I was surprised to see it commence eating. It continued eating some days longer, before changing to a chrysalis. I then tried others in the same way, and also took off quite a number of larvæ, shutting them away from food. Some of the larvæ that I deprived of food in this first experiment died, but all that completed their transformations were males; while those that I induced to go on feeding by tempting them with the best and freshest food proved to be females.

This season (1872) I commenced with the larvæ the 17th of June, and continued feeding broods of different ages through the month of July. Early in July I had about two hundred larvæ feeding at the same time. The room in which I conducted my experiment faced east and south, and toward noon of each of those excessively hot days in the early part of July, it was several degrees warmer than in the outside air. The food-plant on which I fed the various broods was placed in jars of water, which were

set in a large box partly filled with earth, the whole being covered with deep blue mosquito-netting. Heat and moisture seemed favorable to health and rapid growth.

On the 25th of June one lot of eggs hatched, on the 10th of July they were chrysalides, and on the 18th of the same month the butterflies appeared, only requiring twenty-three days for the complete transformation. On the other hand, I have had this same Asterias butterfly eleven months in coming to maturity; some larvæ that hatched in August, 1871, I fed eight weeks, but the nights were cool and some days were absolutely cold, when the larvæ would not eat. These chrysalides I preserved during the winter, and early in June, 1872, I put them in this same warm room in which the larvæ grew so rapidly, and they were in this room some two weeks before the first larvæ of this season were hatched; and strange as it may appear, some half dozen butterflies of this year's brood came out before these last year's chrysalides produced butterflies.

Very soon after the last moult, I shut a number of the larvæ away from food, putting them in paper boxes, from five to ten in a box, carefully labelled. If, at the end of two or three days, the larvæ were still wandering about, I fed them sparingly; in this way I did not lose a single specimen in the larva state by shutting away from food; a few of the chrysalides died.

It was with the most intense interest that I watched the coming forth of the butterflies, which began to appear in about eight days after assuming the chrysalis stage. Thirty-four males came from my male boxes, and then a rather small female made its appearance. Out of seventy-nine specimens that I labelled males, three females were produced. On the other hand, those that I fed up, keeping them on a good supply of fresh food, I labelled females, and placed them in separate boxes. Out of these boxes sixty-eight females came and four males.

There were some boxes that I marked doubtful, which I do not include in the above figures. For instance, I took five larvæ that were eating vigorously; if let alone they probably would have eaten a day or two longer, but I wished to try them in all stages of growth, and these were of quite a large size; out of these five, four were females.

Soon after the last moult, I took twenty larvæ and shut them away from food for twenty-four hours. At the end of that time I

replaced ten on a good supply of food, watched them carefully, and kept them eating until they attained a large size; they became chrysalides within a few hours of each other, and emerged as butterflies eight days after. One of these chrysalides was accidentally crushed; the remaining nine were females. Of the starved ones, eight males came out; the remaining two chrysalides died.

The butterflies, as fast as they made appearance, were killed and pinned up, the males arranged on one side, the females on the other — a most brilliant display, covering a much larger space than one would be apt to imagine.

It would seem, then, as the result of the whole experiment, that sex is not determined in the egg of insects, and that the female requires more nourishment than the male. Nor does this appear strange, when we consider the reproductive nature of the female. It has frequently been said to me, "if your theory is true, it makes the female higher in the scale — superior to the male." I believe it has always been admitted that the female gives birth to the young. If this is considered superiority, then the female is superior; but if beauty of form and color is taken into account, then the male insect is superior, the same as with birds and the higher animals. Carry the analogy further — up to human beings — and still we find the principle holds good. To which sex belong all our great inventors, statesmen and philosophers? I believe woman is physically incapable, other things being equal, of becoming as profound a philosopher, as deep a thinker, as man. I do not wish it understood that I deem woman inferior to man; there is no inferiority, no superiority. If this matter were better appreciated, we should hear less of "woman's rights," and equality of the sexes, and woman would quietly take her place by the side of her brother, with no contention for rights.

But to return to some corroborations. Toward the last of May, some twenty half-grown larvæ of *Vanessa Antiopa* were brought to me. I placed the branch on which they were feeding in a jar of water, turning a wooden box over them, and thought no more of them for over a week, when I uncovered them and found the branch had fallen from the jar, and the leaves were so dry I could powder them in my hand. More than half of the larvæ were dead; eight poor, starved-looking specimens were alive, and completed their transformations. With this butterfly it is difficult

to distinguish the sex by the marking on the wings, so I dissected them and the result proved them males.

Again, I found a larva new to me, feeding on the soft maple. I obtained thirty-three good specimens. I was very anxious to rear these, so I watched them closely, and plied them with fresh good food; if one fell or wandered from its food I replaced it, and continued this treatment until they would eat no longer. They went into the earth to undergo transformation, and in ten or twelve days thereafter, the rare, beautiful moth, *Dryocampa rubicunda*, made its appearance. Of these there were twenty-nine females and two males. The remaining two either escaped or died in the earth.

About the time these moths came out, another lot of the same Dryocampa caterpillars was brought to me, but these were purposely neglected. I found them more than once wandering about the box in quest of food; some of these were killed by a parasite, others died from lack of food, so that the result proved only seven males, and no female.

THE FLYING SQUIRREL.

BY PROF. G. H. PERKINS.

Over a year ago, I bought of some boys in central Illinois a pair of flying squirrels (*Pteromys volucella* Des.). They were only a few weeks old but were already quite tame; indeed they had never been otherwise for they were taken before they could run from the nest and so were taught to be tame at the outset. Their habits have been very closely watched since I have had them in my possession, for so amusing and interesting are they that it is quite difficult to be in the room where they are without watching their movements. I have noticed some facts in regard to them which I do not find mentioned in any account that I have seen. Intense activity characterizes them at all times, but it is more intense at some times than at others. In warm weather their movements are generally quicker and their exercise continued much longer than in cold. In summer they are more nocturnal in their habits than at other seasons.

During this season they usually lie hidden in the nest all day, rarely making their appearance before dusk, and staying out but a few minutes at a time when they do appear during the day; and what is said hereafter in regard to their activity refers especially to their habits in warm weather, though not untrue for the rest of the year. In the fall and winter months they are less strictly nocturnal, coming from the nest several times each day and taking food and exercise, after which they resume their nap, and at night they alternate sleep and activity in the same manner.

When the sleeping and waking are thus interchanged throughout the day, the squirrels are not as active in their exercise nor does the slumber seem so deep as when they sleep all day and are awake all night. The nest is a hemisphere of wire netting with an opening at the top, filled with tow and cotton. When ready to retire they plunge head foremost into this filling and, by moving from side to side, quickly bury themselves so completely that the top of the nest is left smooth and even, and gives no sign of life beneath so long as the inmates are asleep. If some inquisitive hand pulls off the material covering the squirrels, they are found at the very bottom of the nest, each rolled into as complete a ball as possible, with the broad, feather-like tail curled around one side or thrown over the face. When fairly settled for a nap they are not easily aroused, and all the return they give one for gentle pokes, pushes and strokings is a brisk, querulous scolding in sharp, squealing tones, or a blow or two from a fore paw, and then if they are still further disturbed, one or two quick bites from the sharp needle-like teeth, which, however, are so short and slender that they do not inflict very serious wounds. As has already been stated, they do sometimes come from the nest during the day, when most nocturnal in their habits, especially if thirsty; for, if hungry, they eat some of the many nuts which they have hidden in the nest. In quite marked contrast with their sprightliness of action at night are their sleepy half dazed movements at such times. Often after drinking and hopping about the cage a little, they sit motionless; for perhaps half an hour their eyes staring as if wonderstruck and thus they remain till, with a sudden leap, they bury themselves in the nest.

At dusk they begin to stir. Not all at once it would seem do they awake, for the material of the nest quivers and shakes for sometime before the squirrel appears. When, however, they con-

clude that they are all ready, out pop their heads, each to be followed by the rest of the body, after a glance on all sides with the glistening black eyes; and now all drowsiness has disappeared and an activity more incessant and intense than can be described takes its place. All night long, often with only the briefest rest now and then, these little animals are in vigorous motion, jumping, bounding, capering, running with ever varying movement and astonishing energy. Everything they do is done with all their might. It would seem to any one watching them that the exercise of the first few minutes must wholly exhaust their powers, but, on the contrary, the more their muscles are used, the more capable of use they seem, and great as is the energy of their movements at first, they usually increase in vigor and speed until after midnight and scarcely grow less before morning. Nothing affords them so much gratification as a large wheel which is placed inside the cage. Into this wheel they jump whenever aught disturbs or pleases them, and even when quite hungry they often find it necessary to take a few turns before commencing their meal, after which exercise they draw themselves into a bunch with the tail over the back after the manner of squirrels, and set briskly to work on the nut or other food which they may have received. They are almost as fond of riding as of running and work their passage by running till the wheel is in rapid motion and then clinging to its wires, and so are carried around and around, the pure white of the under side of the body contrasting prettily with the soft brownish-gray of the back and sides as each comes into view. When both are in the wheel one often rides while the other turns the wheel, the latter bounding over the other as each turn brings him around, and, no matter how rapidly the wheel turns, these movements are executed with perfect exactness and gracefulness. Being desirous of knowing with some degree of accuracy how rapidly the wheel moved, I made some experiments for that purpose and found that the usual rate of revolution was from sixty to over a hundred and twenty times a minute, and, as the wheel is forty-four inches in circumference, when its rate is the latter of the two numbers named, the squirrel turning it must travel four hundred and forty feet a minute, or about five miles an hour, a distance requiring a great many steps when they are so short as squirrels must take. The sides of the wheel are formed of spokes radiating as in any wheel, these spokes are only five inches apart at the circumference and of

course constantly grow less towards the centre; yet through this narrow space which passes, when the wheel is at full speed, in the sixteenth of a second, they dart in and out with perfect ease. So quickly do they move that the eye can scarcely follow them; one instant a squirrel is in the wheel running with all his might, and the next he is seated on a shelf at the opposite end of the cage, the wheel whirling behind him. They rarely check the speed of the wheel when wishing to leap out, but when it is in motion and one wishes to enter it, he often clings to one of the spokes and as he is borne around, sidles in. When, as in summer often occurs, the wheel is kept in motion at full speed for nine or ten hours, with very little rest, the distance which the squirrels have travelled is not inconsiderable, being much more than most men could perform day after day, and yet they never seem in the least weary but are ready at any time for a fresh start. Their chief locomotive power resides in the hind pair of legs, which are so powerful that the body can easily be held horizontally by them, the feet clinging to a wire of the cage as the only support of the whole. In most rodent animals the front legs are comparatively weak and are used mainly for holding food, and when the animal is running they seem rather to move in response to the pushing force of the hind legs than to aid very much in propelling the body. They usually move about the cage or room, or in the wheel, by running as other animals would, but sometimes they change this for a series of short leaps, or leaps which again may change into bounds of considerable length; and very graceful are these latter, so light and easy do they appear. Indeed, it is impossible for them to be awkward or clumsy in any of their movements. Though usually very quiet they are not always displeased with noise, if it be a lively one; for instance, they drop a nut in the wheel and then as it rattles when the wheel moves they are highly delighted, sometimes more so than some of the other listeners. Once when a butternut thus became quite a trouble to me I removed it, but no sooner had I left the cage than they put it back and set it rattling louder than ever, leaping over it as it came near them and jumping about as if performing a war dance, and this they repeated over and over again till, finally, the nut was removed from the cage. Now and then the freak takes one or the other to leave the wheel altogether for several days, and in the meantime they relieve their over-buoyant feelings by executing a brilliant series of somer-

sets with an agility and daring that would excite the envy of the most skilful acrobat. They always turn backward, going completely over and alighting almost exactly upon the spot from which they started. Now they run a few steps before going over, and now stop and turn round and round as if a spit ran through the centre of the body on which it turned. These gyrations are often extremely ludicrous, especially, when turning side by side, they seem to be racing. Their heads appear to be wholly ignorant of dizziness or other unpleasant sensations that come from an inverted position, for it never makes much difference with them whether the head is up or down, sometimes taking food hanging head down, and almost always drinking in this position; as they might, when wild, drink from a stream while clinging to the end of an overhanging branch, though it is singular that they should so invariably choose this position, as they drink by lapping up the water as a cat would.

They are so tame that they have very little idea of running away, not always being ready to leave the cage when it is opened to allow them to do so. They are often allowed to run about the room in which they are kept and they are quite fond of running over the furniture, leaping into chairs and off the backs, running over picture cords and the like, being better pleased as they climb higher, and when as high as they can get, off they "fly" to the farthest corner of the room. It is hardly necessary to say that this so called "flying" is in no sense true flight. The extension of skin between the front and hind limbs is not capable of motion like that of a wing of a bird, nor can it raise the body from any surface, but it is simply a support, a parachute, so that the animal can leap from a high position and by a gradual descent reach the ground. So efficient is this support that in the woods these little animals can sail down from a high tree to a bush several hundreds of feet away. They always choose a bush or branch upon which to stop if possible, and even in a room, when descending from a bookcase, they always alight, if possible, on a chair or a person's shoulder rather than upon the floor. Not only when descending but when jumping up does the parachute assist them, and if they are liable to fall they partly extend it. When fully expanded it makes the outline of the body about square, a little longer than broad, but when folded along the side it is not noticeable, as it is covered with fur of the same color as the body, white below and gray above, with a dark line along the edge, and like all the fur of

the body is most beautifully fine and soft. Like the eyes of all squirrels, those of the species under consideration are very large and unusually prominent, standing from the head like great black beads. They seem to be useful both by day and night. Light, even if it be quite bright, does not seem to be an inconvenience, and it is quite certain that they can see very well in the dark, as they leap about the cage and find their food in the darkest night as well as by daylight, and a light brought near them does not seem to affect them disagreeably. The natural food of the flying squirrel consists of nuts, buds, fruits and the like, but they are ready to at least taste of anything that may be offered them, and if it is anything that can be eaten the chances are that it will be. I once found one of them at my inkstand eagerly lapping the ink as if he enjoyed it greatly; pretty soon, however, he left it with sneezings, sniffings and grimaces of a most comical sort, but the very next chance he had he tried to get some more. Salt they eat greedily and also sugar. Beetles they are very fond of and several birds' eggs which I left in their way they devoured, shells and all. They are very neat in all their habits, keeping their faces clean by often rubbing them with the front paws, and the fur of the whole body is always clean and in order.

I am inclined to believe that the flying squirrel does not possess as much intelligence as the gray or red or some other species. Very few of their actions appear to be controlled by anything higher than instinct. They seem to be quite fond of each other, and lonely when separated for any length of time, despite an occasional sharp squabble over some article of food, but they do not evince much attachment for those who feed and care for them. In their rapid and noiseless flitting about the cage they remind one of birds, and their motions are as light and airy, but if disturbed in any way, especially when seated to enjoy a nut, they express their displeasure by a series of quick, sharp squeaks and in their quarrels they scold each other in the same manner. When especially eager to get any food that is held near the cage they run towards it with brisk chuck-chucks, at the same time shaking all over in their anxiety to seize it. More rarely they utter another sound, a clear musical note usually melodious and pleasant but occasionally shrill. This sound very closely resembles the chirp of some birds, so much so that when the windows are open and birds sing-

ing near them, a stranger almost always is deceived as to its source, thinking it caused by the birds outside rather than by the squirrels inside. They keep up this noise for perhaps ten minutes, perhaps half an hour, for no discoverable reason. They are exceedingly inquisitive, prying into everything that comes in their way; and, if watched and fearful lest they are to be interrupted, they assume a most impudent and reckless air, glancing out of one eye, and shaking their heads and sniffing every now and then for an instant, and then returning to their investigations with renewed energy, pulling away desperately at anything that can be laid hold of, and if anyone starts towards them to drive them away, they wait till the very last minute, when, with a twinkle of the eye, a toss of the head and jerk of the tail, they are off and across the room in a trice, perhaps stopping to chatter their disapproval of the whole proceeding as soon as safely out of reach. It is difficult, if not impossible, to so conceal nuts or corn that they do not immediately discover them and dig and pull and push at whatever contains them till they get them. It must be by the aid of their keen scent that they are thus able to detect the food when closely covered in a box. When their exertions have been successful, they do not allow anything that can be eaten, to remain where they have found it, however snug the place may be, but carry it off to some other place of their own choosing. One evening they carried over sixty walnuts, from a box in which they were kept, across the room and by climbing the handle of a feather duster reached a bracket on which was a large vase, and into this they put the nuts, one by one, giving each a rapping against the vase as it was left.

When the actions of an animal are so suddenly varied, so constantly changing and of such interest in all their phases as are those of the flying squirrel, a complete account can scarcely be given. Certainly it is not easy for words to represent the merry, rollicking, don't-care manner in which these flying squirrels do everything. Such a combination of earnestness and carelessness is seldom seen. For they are earnest about their work, and in emptying a box of nuts they seem to feel the great importance of their undertaking and the necessity of soberness and dignity in its execution, but yet one can not help seeing that all this is but assumed for the occasion, for their eyes, and indeed their whole body, are all the time expressive of mischief, and the little rogues

are never so sedate that they do not seem to be bubbling over with fun and to be ready at a moment's notice to engage in any mischief that may occur to their scheming little heads.*

INDIAN NETSINKERS AND HAMMERSTONES.†

BY CHARLES RAU.

THE two kinds of Indian stone implements which form the subject of this article are by no means remarkable for skilful workmanship, and therefore, probably, have thus far attracted little notice in this country. In archæology, however, every object that can serve to illustrate the former condition of a people is of significance, and it matters not whether that object is elaborately finished or has suffered but little alteration by the hand of man. I place netsinkers and hammerstones together, because the specimens in my possession, which form the basis of my description, were derived from the same locality, namely, both banks of the Susquehanna river near the small town of Muncy, in Lycoming County, Pennsylvania. I possess a great number of the above-named implements of all shapes and sizes, which were sent to me by Mr. J. M. M. Gernerd, a resident of Muncy. To this gentleman I am also indebted for the communication of the details which enable me to furnish the following account.

* Since the main portion of this article was written, one of the pets has died. It is the female that is lost — the tamest and best natured, but least sprightly of the pair. It is to be feared that she was killed by kindness, as she had been fed on soft food much of the time, and so did not have to crack nuts for a living. A post mortem showed that the body was covered with thick layers of fat; and more than this, that he abdominal cavity was more than half filled with solid masses of fat; so as there was no other visible cause for her decease, the inference is that she died of *adiposity*. It is sad to say aught that may d minish anyone's admiration for these really charming animals, but truth requires me to say that I have watched in vain for any signs of grief in the remaining squirrel. He sleeps as soundly and performs his various gymnastics as gleefully as ever. The only difference in his conduct I am able to detect is, that whereas formerly he instantly seized any and everything that was offered, he is now quite particular, entirely refusing many articles that used to be a part of his diet. It may be that grief affects his appetite; but it is to be feared that, having discovered that there is no one to snatch his food if he does not eat it, he takes time to choose that which is most agreeable. At any rate all the evidence goes to show that these really attractive creatures do not possess any deep affect on even for each other.

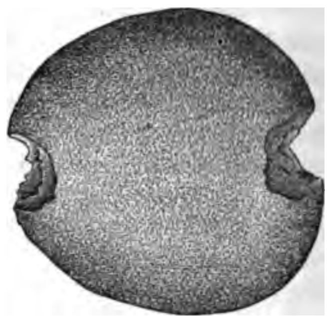
† Translated by the Author from Vol. V of the "Archiv für Anthropologie."

Netsinkers and hammerstones are found in various localities of the United States; but I am not aware that they occur in any other place as frequently as in the neighborhood of Muncy. Netsinkers have been taken away from there by the hundred, and yet their number is not exhausted; hammerstones, however, although likewise numerous, occur there less frequently. The other productions of primitive art, which always indicate the former presence of the Indians, such as stone tomahawks, wedge-shaped stone implements, flint arrowheads, fragments of coarse pottery, etc., are also found in the environs of Muncy.

The netsinkers in question are flat pebbles of roundish or angular (generally indefinite) shape and of various sizes, which exhibit

Fig. 30.

Fig. 31.



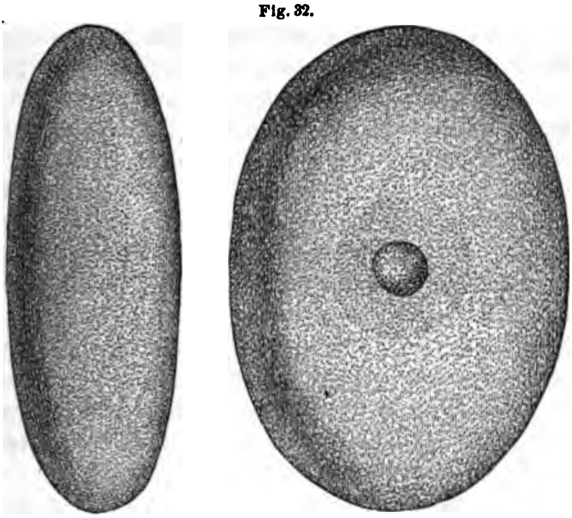
Netsinkers (one-half natural size).

on two opposite points of the circumference an indentation or notch, more or less deep, and produced by blows. Besides the notches, which facilitated the attachment to the nets, these pebbles have not undergone the slightest change by human agency; and their manufacture, therefore, required but little labor and skill. My smallest specimen measures two inches in diameter and weighs only half an ounce; my largest one, a flat stone of irregular outline, is eight inches wide across the broadest part and weighs two pounds and fourteen ounces. I must mention, however, that the last-named specimen is unusually large and heavy, the average size

of the sinkers being from three to five inches, with a corresponding weight of from six to ten ounces.

Figures 30 and 31 represent netsinkers of my collection in half-size, which weigh respectively eleven ounces and seven ounces and a quarter. The original of Fig. 30 is in the middle five-eighths of an inch in thickness, that of Fig. 31 is about seven-eighths of an inch thick. Sinkers with four notches also occur near Muncy, though not very frequently, and in these cases the notches are so placed that the stone was encompassed crosswise by the strings or thongs which connected it with the net.. One of the specimens found at Muncy is even provided with. seven indentations. The

Fig. 32.



Hammerstone (one-half natural size).

material of these netsinkers is almost exclusively a flat-breaking silico-argillaceous stone of gray or brownish color, sometimes containing diminutive particles of mica, and consequently bearing the distinct character of graywacke. The latter kind of rock belongs to the geological formation of Muncy, and occurs also in numerous pebbles in the neighboring creeks, which empty into the Susquehanna. The Indians, therefore, had little difficulty in obtaining the stones used as sinkers.

No greater skill was required in the manufacture of the hammerstones. They are nearly always roundish or oval pebbles of a somewhat compressed or flattened form, presenting in their side-view

the outline of a more or less elongated ellipse. Their only artificial alteration consists in two small pits or cavitiès, so placed as to form the centres of the opposite broad sides of the pebble. In these cavities the workman placed the thumb and middle finger of the right hand, while the forefinger pressed against the upper circumference of the stone. Figure 32 (two views) is a half-size drawing of one of these hammerstones, and may serve to represent their general character. The original of Figure 32, however, is one of the larger specimens, measuring a little more than five inches in longitudinal diameter, and weighing one pound and ten ounces. Most of the hammerstones are smaller and lighter, averaging about a pound in weight. My smallest specimen, almost circular and with a diameter of two inches and three-quarters, weighs only half a pound. Concerning the cavities on the opposite sides, I will state that the makers evidently chiselled them out, as it were, with a tool of hard stone, doubtless a pointed flint, for which reason they sometimes appear rough and irregular. In the more finished specimens, however, they exhibit regular cup-like concavities, obviously produced by grinding. In some instances the depressions are so shallow that they almost escape observation, while they reach in other cases from eight to nine millimetres into the stone, and thus afford the hand a firm hold. Yet quite a number of the hammerstones under notice exhibit, instead of the cup-shaped cavities, on the opposite broad sides, *roughly* ground faces, sometimes several inches in diameter, and answering well the purpose of allowing the hand a secure grasp of the stone. Many of the hammerstones bear the distinct traces of use, being battered and crumbled at the circumference; and a few of the specimens in my possession are even burst as far as the centre by the force of the blows dealt with them. The material of the hammerstones of Muncy is a tolerably hard stone consisting of rounded quartz grains, apparently a metamorphic quartz, or quartzite.

In Europe, it is well known, similar hammerstones occur, which have been called *Tilhuggerstene* by Danish archæologists.* Prof. Nilsson has minutely described these implements, and tried to prove they had been used in chipping weapons and tools of flint.

* Drawings of European hammerstones resembling those of the Indians are found in the following works — Nilsson: The Primitive Inhabitants of Scandinavia (London 1868), Pl. I, Fig. 1; Worsaae: Nordiske Oldsager etc. (Copenhagen 1859), Figs. 32, 33; Stevens: Flint Chips (London 1870), Fig. 122; Evans: The Ancient Stone Implements, etc. of Great Britain (London 1872), Figs. 161, 164.

It is not my intention to enter here into a discussion concerning the views of the meritorious Swedish archæologist: I will merely state my opinion in regard to the probable use of the hammerstones from the Susquehanna valley. That these latter were employed as hammers cannot be doubted, since they show the most distinct traces of violent contact with hard substances; yet, according to my view, it was almost impossible to employ them *immediately* in fashioning flint implements. They are by far too clumsy, and possess too much roundness on all sides to have been the tools for fabricating arrowheads and other delicate articles of flint.* Not even the rude notches in the netsinkers could have been produced by their immediate application. Nevertheless, they may have served, besides fulfilling other purposes, as *coöperating* tools in the manufacture of flint implements. Mr. Catlin has described the method employed by the Apaches and other western tribes in making flint points for arrows and spears. The work, he states, is performed by two persons, one of whom holds the piece of flint to be operated upon in the left hand and places with the right hand a chisel or punch (made of a tooth of the sperm-whale) against the protuberances of the flint, which are to be removed, while his assistant strikes the chisel on the upper end with a mallet of hard wood and thus flakes off the projecting points. This process is continued until the article has acquired the desired shape.† A similar method, perhaps, was in use among certain Indians inhabiting the eastern parts of North America, and in this case the hammerstones may have replaced the wooden mallets mentioned by Catlin.

Yet while I doubt the immediate application of these heavy hammerstones in the manufacture of flint points, I do not deem it altogether improbable that they were directly used as hammers for chipping certain rude implements of graywacke, or a kind of tough slate, which occur in great abundance in the neighborhood of Muncy. These implements are of various shapes, mostly wedge-like in form, and are sometimes quite large. Many of them have

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*Among my specimens from Muncy there is a hammerstone of flint, which may have been used directly in making arrowheads. It is a nearly round, somewhat flat stone, two inches and three-eighths in diameter, and weighing six ounces and a quarter. The edge or rather circumference is much battered by continued use. Similar flint hammerstones found in England, are figured on page 223 of Mr. Evans' new work, "The Ancient Stone Implements, Weapons, and Ornaments of Great Britain."

†Catlin: Last Rambles amongst the Indians, New York, 1867, p. 187.

distinct scraper-edges, and probably were used in the preparation of hides and for other kindred purposes. I further believe that there is a certain connection between the netsinkers and hammerstones of Muncy, in so far as the latter served in the manufacture of the former. Two workmen, I imagine, were active in the operation. One held the pebble, its narrow side upward, firmly in the hand; the other placed a piece of flint of suitable shape and strength at the spot where the notch was to be cut out, and gave the flint wedge a heavy blow with the hammerstone, thus effecting the indentation. In this manner a great many sinkers could be made in a short time.

From the great number of netsinkers found near Muncy, it may be deduced that the Indians were much engaged in fishing at this point. Indeed, the Susquehanna is here about nine hundred and fifty feet wide, very deep in some places, and well stocked with fish, among which I will mention perch, pike, sunfish, catfish, and eels. There existed formerly a shad-fishery near Muncy, before the river was obstructed by dams. Salmon is still sometimes caught. Formerly, however, fish were still more abundant, and the locality, therefore, afforded the aborigines great advantages as a fishing-station. When the first white settlers penetrated to this region, they found on or near the present site of Muncy a village of the Minsi or Munsey Indians, the Wolf tribe of the great Leni-Lenape or Delaware nation. The name "Muncy," indeed, perpetuates the tribal designation of those aboriginal predecessors, whose scanty descendants now dwell, far from the home of their fathers, in the districts beyond the Mississippi. The Minsi Indians, I think, may be considered as the manufacturers of the stone implements described in these pages.

Netsinkers of stone are even in our time in use among certain tribes of the northwest coast of North America; as for instance, among the Chinooks (at the mouth of the Columbia river), who attach them to their salmon-nets. "Their nets," says Mr. Swan, "are made of a twine spun by themselves from the fibres of spruce roots prepared for the purpose, or from a species of grass brought from the north by the Indians. It is very strong, and answers the purpose admirably. Peculiar-shaped sticks of dry cedar are used for floats, and the weights at the bottom are round beach pebbles, about a pound each, notched to keep them from slipping from their fastenings, and securely held by withes of cedar firmly twisted and

woven into the foot-rope of the net. The nets vary in size from a hundred feet long to a hundred fathoms, or six hundred feet, and from seven to sixteen feet deep." *

Fishing-nets may be counted among the utensils invented at very early periods, on the spur of necessity, by men in various parts of the world. That they were already in use in Europe at a remote time of antiquity is proved by their remnants preserved in an almost marvellous manner in the Swiss pile-constructions of the stone age, as, for instance, those of Robenhausen and Wangen. In the earliest works on North America the fishing-nets of the Indians are mentioned, but not described. Cabeça de Vaca, the first European who gave an account of the interior of North America, refers in various places, though in a transient manner, to the nets of the natives whom he met during his long wanderings.† Garcilasso de la Vega and the anonymous Portuguese gentleman, called the Knight of Elvas, the two principal authors who have left accounts of De Soto's expedition (1539–43) are likewise deficient in all such details as might serve to illustrate the original character of Indian nets. The latter relates, however, that the Spaniards, while at a place near the Mississippi, called Pacaha (Garcilasso has it "Capaha"), caught fish in a lake with nets furnished by the Indians.‡ This establishes at least the fact that the tribes of the Mississippi valley employed fishing-nets, when first seen by Europeans. The Indians of the present New England States made strong nets of hemp. For this we have the authority of Roger Williams, who gives also the word *ashóp*, which signifies a net in the language of the Narragansetts.§ Yet it appears that the Indians of the Atlantic Coast (and others) practised more the "spearing" of fish than their capture in nets. Some were also killed by arrow-shots.‖ According to Van der Donck,¶

* Swan: The Northwest Coast, New York, 1857, p. 104.

† Relation et Naufrages d'Alvar Nuñez Cabeça de Vaca (Ternaux-Compans), Paris, 1837, pp. 24, 142, 177, 179. Original printed at Valladolid in 1555.

‡ Narratives of the Career of Hernando de Soto, etc., translated by Buckingham Smith, New York, 1866, p. 112.

§ Roger Williams: A Key into the Language of America, London. 1643; Providence, R. I., 1827, p. 102.

‖ The practice likewise prevailed of erecting in the water large labyrinth-like enclosures of lattice-work, flanked by long weirs, the whole forming a sort of gigantic trap, into which the fish were driven. Such a contrivance of the Virginia Indians is figured and described in the first volume of De Bry's "Peregrinationes" (Frankfort on the Main, 1590).

¶ Beschryvinge van Nieuw-Nederlandt, Amsterdam, 1656, p. 70.

the Indians in the neighborhood of New Amsterdam (now New York) employed, during the middle of the seventeenth century, various kinds of nets; but this author does not state whether these nets were original Indian inventions, or adopted from the Dutch colonists. The Natchez, on the Lower Mississippi, made their nets from the bark of the linden tree, and knitted them quite in the European fashion.*

Reverting, in conclusion, once more to netsinkers, I will mention that in the United States there also occur some provided with a perforation, instead of being notched. I had occasion to examine in the collection of Col. Charles C. Jones, of Brooklyn, a number of the perforated kind, which the owner had found in Eastern Georgia, at the confluence of the Great Kiokee Creek with the Savannah river, a spot where Indian relics abound. The material of these sinkers is the talcose stone commonly called soapstone. They consist of flat smoothed pieces, of indefinite but mostly rounded outline, which are an inch or less in thickness, and measure from three to six inches in diameter. The holes are usually drilled from two sides, and therefore narrowing in the middle, where they are about half an inch wide. Col. Jones will figure and describe these Indian implements in his forthcoming work on the antiquities of the State of Georgia.

THE FOSSIL MAMMALS OF THE ORDER DINOCERATA.† — *With Two Plates.*

BY PROFESSOR O. C. MARSH.

AMONG the many extinct animals of interest hitherto discovered in the Tertiary of the Rocky Mountain region, none, perhaps, are more remarkable than the huge mammals which have recently been described from the Eocene beds of Wyoming. It is important, therefore, that accurate information in regard to them should be promptly made public, especially as serious errors on this subject have already appeared in various scientific publications, and are being widely disseminated.

* Du Pratz: Histoire de la Louisiane, Paris. 1758. Vol. II, p. 179.

† Published in part in the "American Journal of Science," Vol. V, p. 117, Feb., 1873.

These animals nearly equalled the elephant in size, and had limb bones resembling those of Proboscidians, as stated in the original description of the type species, *Tinoceras anceps* Marsh. The skull, however, presents a most remarkable combination of characters. It is long and narrow, and supported three separate pairs of horns. The top of the skull is concave, and on its lateral and posterior margin there is an elevated crest. There were large decurved canine tusks, somewhat resembling those of the walrus, but no upper incisors. The six premolar and molar teeth are quite small. Several species of these remarkable animals have already been named, but at present they cannot all be distinguished with certainty. The type species of the group (*Tinoceras anceps* Marsh) was based on the specimen first discovered; which was found by the Yale College party in September, 1870, and described by the writer in June, 1871, under the name *Titanotherium? anceps*.* In the following year Professor Cope gave the name, *Loxolophodon semicinctus*, to a single premolar tooth, which perhaps, belongs to this group, and may prove to be identical with the above species.† In August last, in a paper issued in advance of the Proceedings of the Philadelphia Academy, Dr. Leidy described a characteristic specimen as *Uintatherium robustum*, and likewise gave the name *Uintamastix atrox* to an upper canine tooth, probably of the same animal, on the supposition that it pertained to a carnivore.‡

The remarkable feature in the skull of this group was first indicated in the name *Tinoceras*, proposed by the writer (August 19, 1872) for the genus represented by the type species, and subsequently mentioned in the American Journal of Science.§

The Museum of Yale College contains the remains of many individuals of the order *Dinocerata*, including the types of the various species described by the writer.‖ All of these are well represented by characteristic specimens, and one species, *Dinoceras mirabilis* Marsh, by an entire skull, and a nearly perfect skeleton. An opportunity has thus been afforded of determining with some

* American Journal of Science, Vol. ii, p. 35.

† American Philosophical Soc., Vol. xii, p. 420.

‡ Proceedings Philadelphia Academy, 1872, p. 169.

§ Vol. iv, September, 1872, Erratum; also October, 1872, p. 322.

‖ American Journal of Science, vol. iv, pp. 322, 323, 343, Oct., 1872. Also Proceedings American Philosophical Society, vol. xii, p. 578, Dec., 1872, and American Naturalist, vol. vii, p. 52, Jan., 1873.

certainty the nature and affinities of this most singular group of animals, and the more important characters are here mentioned, preliminary to the full description. Most of the cranial characters are derived from a very perfect skull of *Dinoceras mirabilis*, figured in the accompanying plates.

The skull is unusually long and narrow. The three pairs of horn-cores, rising successively above each other, and the huge crest around the deep concavity of the crown, together with the large decurved trenchant tusks, unite in giving a most remarkable appearance to the entire head (Plates I, II), which differs widely from anything known among living or fossil forms.

The structure of the skull presents many features of interest. The supraoccipital is greatly developed, and, after rising above the brain-case, forms an enormous crest, which projects obliquely backward beyond the condyles. This crest is continued forward on either side, each lateral portion sloping outward, and overhanging the large temporal fossa. This portion of the crest is formed largely of the parietals. The posterior pair of horns rise from this crest, which is thickened below on the inner side to support them. In front of these horns, the crest descends rapidly, and subsides nearly over the centre of the orbit. These posterior horn-cores are higher than those in front, and have obtuse summits, flattened transversely. (Plates I, II.) The frontal bones have no postorbital process, and the orbit is not separated from the temporal fossa. The latter is very large posteriorly. (Pl. II, fig. 1.) The squamosal forms the lower portion of the temporal fossa, and sends down a massive post-glenoid process. It likewise sends forward a zygomatic process, which resembles that of the tapir. The malar completes the anterior portion of the arch, which is not the case with any known Proboscidian. The lachrymal is large, and forms the anterior border of the orbit, as in the rhinoceros. It is perforated by a large foramen on its facial surface. Over the orbit, the frontal sends out laterally a prominent ridge, which afforded good protection to the eye in the combats of these animals with each other. On this ridge there is a small protuberance, which closely resembles a diminutive horn-core, but its position, immediately in front of the lateral crest, renders it probable that it did not support a true horn.

The maxillaries are massive, and quite remarkable in supporting a pair of stout, conical horn-cores. The bases of these cores

approximate, and their summits are obtuse and nearly round. (Plates I, II.) Below these horns are the huge decurved canines, the extremity of the fang being implanted in the base of the horn-core. Behind the canine, there is a moderate diastema, followed by six small premolar and molar teeth. The crowns of the molars are formed of two transverse ridges, separated externally, and meeting at their inner extremities. The nasals are massive, and greatly prolonged anteriorly. In front of the zygomatic arch they contract, and form the inner inferior surface of the maxillary horn-cores, as well as an elevation between them. From this point forward to the anterior margin of the suture with the premaxillary, they increase slightly in width, and then contract to the end of the muzzle.

Near the anterior extremity of the nasals, there is a pair of low tubercles, which evidently supported dermal horns (Pl. II, fig. 3). The premaxillaries are without teeth, and quite peculiar. They unite posteriorly with the maxillaries just in front of the canine, and then divide, sending forward two branches, which partially enclose above and below the lateral portion of the narial opening. The upper branch is closely united with the adjoining nasal, thus materially strengthening the support of the nasal horns. The lower portion is slender, and resembles the premaxillary of some Ruminants. The extremity is somewhat behind that of the nasals, The anterior nares are comparatively small, the aperture being more contracted than in the rhinoceros. The lower jaw was slender, and the tusks small.

The extremities in the *Dinocerata* resembled those in the *Proboscidea*, but were proportionally shorter. The humerus was short and massive, and in its main features much like that of the elephant. One of the most marked differences is seen in the great tuberosity, which does not rise above the head, and is but little compressed. The condylar ridge, moreover, of the distal end is tubercular, and not continued upward on the shaft. The lower extremity of the humerus is much like that of the rhinoceros, and the proportions of the two bones are essentially the same. The head of the radius rests on the middle of the ulnar articulation, and hence the shaft of this bone does not cross that of the ulna so obliquely as in the elephant. The femur is proportionally about one-third shorter than that of the elephant. The head of this bone has no pit for the round ligament, and the great trochanter is flattened and recurved. There is no indication of a

third trochanter. The distal end of the femur is more flattened transversely than in the elephant, and the condyles are more nearly of the same size. The corresponding articular faces of the tibia are consequently about equal, and also contiguous, with no prominent elevation between them. When the limb was at rest, the femur and tibia were nearly in the same line, as in the elephant and man. The astragalus has no distinct superior groove. Its anterior portion has articular faces for both the navicular and cuboid, thus differing from Proboscidians, and agreeing with Perissodactyls. The calcaneum is very short. The phalanges are short and stout, and resemble somewhat those of the elephant.

The vertebræ of this group are not unlike those of Proboscidians in their main characters. The cervicals are materially longer than in the elephant. There are four sacral vertebræ, the last quite small, and supporting a short and slender tail. The ribs have rudimentary uncinate processes, as in the mastodon.

Such being the more important characters of these gigantic fossil mammals, it remains to state briefly what these characters collectively indicate, and likewise to give reasons for placing the group in an order distinct from the *Proboscidea*.

The vertebræ and limb-bones in the *Dinocerata* are in many respects remarkably like those of Proboscidians, the exceptional characters being those of the Perissodactyl type. The skull, on the contrary, presents no distinctive proboscidian features. The presence of horns in pairs, and the absence of teeth in the premaxillaries together with the large canine, point toward the Ruminants. The nasal horns, the structure of the anterior portion of the skull, the molar teeth, the zygomatic arch, the elongated temporal fossæ, the large post-glenoid processes, as well as other less important cranial characters, show affinities with the Perissodactyls. The horns on the maxillaries, the deep concavity of the crown, and the huge lateral crests are quite peculiar to this order.

Some of the most marked characters that distinguish these animals from the *Proboscidea* are the following:—1st, The absence of upper incisors. 2d, The presence of canines. 3d, The presence of horns. 4th, The absence of large air cavities in the skull. 5th, The malar bone forms the anterior portion of the zygomatic arch. 6th, The presence of large post-glenoid processes. 7th, The large perforated lachrymal, forming the anterior portion of the orbit. 8th, The small and horizontal narial orifice. 9th, The greatly elongated nasal bones. 10th, The premaxillaries do not

meet the frontals. 11th, The lateral and posterior cranial crests. 12th, The very small molar teeth, and their vertical replacement. 13th, The small lower jaw. 14th, The articulation of the astragalus with both the navicular and cuboid bones. 15th, The absence of a hallux. 16th, The absence of a true proboscis. The last character may be fairly inferred from the short anterior limbs, the moderately lengthened neck, and the very elongated head, which rendered a proboscis unnecessary, as the muzzle could readily reach the ground. The small nasal opening—smaller even than that of the rhinoceros or tapir—also testifies against it, while the nasal horns, and the sharp decurved canines would seriously have interfered with such an organ, had it been present.

The horns of the *Dinocerata* were a remarkable feature. Those on the nasal bones were probably short, dermal weapons, something like those of the rhinoceros, but much smaller. Those on the maxillaries were conical, much elongated, and undoubtedly formed most powerful means of defence. The posterior horns were the largest, and their flattened cores indicate that they were expanded, and perhaps branched. All the horn-cores are solid, nearly smooth externally, and none of them show any indication of a burr. Whether both sexes had horns, cannot at present be decided, but this was probably the case.

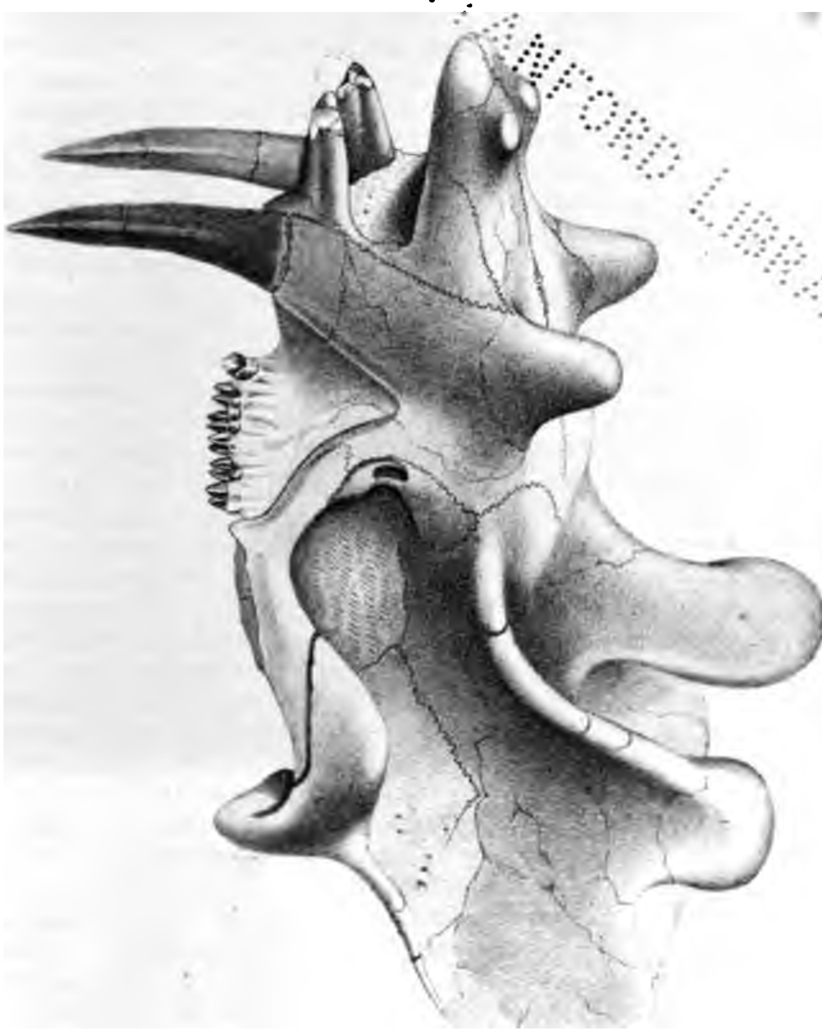
The remains on which this description is based were found in the Eocene deposits of Wyoming, and are now in the Museum of Yale College. A more complete description, with full illustrations, is in course of preparation.

In addition to the descriptions mentioned above, Prof. Cope has since proposed the generic name *Eobasileus*,* and indicated three species, which apparently are not distinct from those previously described by Dr. Leidy and the writer. One of the species named by Prof. Cope (*Eobasileus furcatus*) is based on what he regards as portions of the nasal bones. The description however, indi-

* It is uncertain what date should be assigned to the name *Eobasileus*, and the species included under it by Professor Cope. After a very careful investigation, I cannot ascertain that the descriptions were published before Oct. 29th. 1872, when copies were first received by the Philadelphia Academy of Natural Science, of which Prof. Cope is secretary. The dates on the papers (Aug. 20th and 22d, 1872) certainly do not represent those of actual publication. The descriptions have just appeared (Feb. 6th, 1873) in the "Proceedings of the American Philosophical Society," Vol. XII, p. 485, 487. Several other papers by Professor Cope on fossil vertebrates from Wyoming bear various dates from July 11th to October 12th, 1872, but apparently none of them were published before October 29th, and some of them certainly not until about a month later. As now published in this number of the Proceedings, no less than seven of Prof. Cope's papers are antedated, as the records of the society will show.

cates that these specimens are the posterior horn-cores of other species. Many of the characters given by Prof. Cope in his description of these animals do not indeed apply to the other known species, but it is evident he has made several serious mistakes in his observations. He has likewise been especially unfortunate in attributing to the *Dinocerata* characters which they do not possess; and hence his conclusion, that all these animals are true *Proboscidea*, and possessed a proboscis, is quite erroneous.* In his references and dates, also, Professor Cope has shown the same inaccuracy that has marred his scientific work. It is important, therefore, that his mistakes on these subjects should be promptly corrected, especially such errors as the following: What Prof. Cope has called the incisors are canines, and hence his statement that there are large incisor tusks, but no canines, should be reversed. 2d, the stout horns he described are not on the frontals, but on the maxillaries. 3d, The orbit is not below these horns, but behind them. 4th, The occiput is not vertical, but oblique, the occipital crest projecting behind the condyles. 5th, The temporal fossæ are not small posteriorly. 6th, The great trochanter of the femur is recurved, although Professor Cope says not. 7th, The spine of the tibia is not obtuse, but wanting. 8th, The nasal bones in the *Dinocerata* are not exceedingly short, but much elongated. 9th, The malar bone does not form the middle element of the zygomatic arch, but the anterior, as in the tapir. 10th, The frontals do not have a great prolongation forward, and it is very doubtful if they support horns or processes at both extremities. 11th, The nasal bones are not deeply excavated at their extremities. 12th, The genus *Dinoceras* was not originally referred to the Perissodactyls, but to a new order. 13th, The type species of this order was not described as *Titanotherium anceps*, but as *Titanotherium ? anceps*, a difference of importance, as the reference was merely provisional, and the characters given pointed, not to the Perissodactyls, but to Proboscidians. 14th, The date given to *Eobasileus* (August 20th, 1872) is not correct, as stated on page 151. 15th, The name *Tinoceras* was not first proposed August 24th, 1872, but August 19th, 1872, and on that day I mailed Professor Cope the pamphlet containing it. 16th, The communication I made on this subject before the American Philosophical Society was not December 30th, 1872, but December 20th.

* Proceedings Philadelphia Academy, Jan. 14, 1873.



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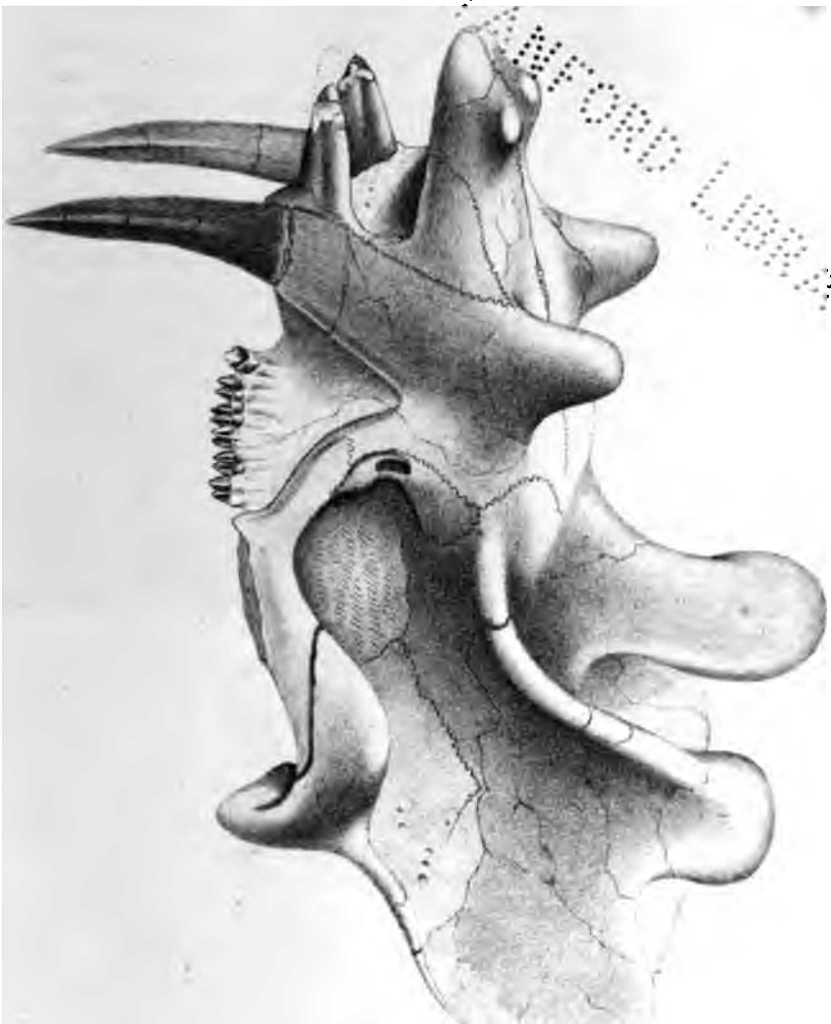


1872, Professor Cope being present. The assertion that it is "exceedingly probable that the tusk of the mastodon and elephant, regarded as an incisor by Cuvier, is really a canine," needs no refutation. If Professor Cope will examine the skull of a young elephant, he will probably find that Cuvier was right after all.

These specific points against his work, Professor Cope has not answered. He has, however, endeavored to break the force of my criticism by a general denial, which evades the main issue between us. He says, in substance, that one species of *Eobasileus*, or rather, one of the five individuals on which this species was based, is different from one of my species. This, however, if established, would not materially diminish the list of his errors on this subject. Professor Cope distinctly included in his group of supposed *Proboscidians* the genera *Dinoceras* and *Uintatherium*, thus mistaking, as I have already shown, both their characters and affinities. Prof. Cope states, moreover, that I have not seen his *Eobasileus*. This is true; nevertheless, I will venture, with due diffidence, to express my belief that he is mistaken in regard to several important characters of this genus; and I have a suspicion that, when carefully studied, it will turn out an orthodox member of the *Dinocerata*, and, not unlikely, a near relative of *Tinoceras*.

Professor Cope reasserts, likewise, that the descriptions he has given are correct. This, however, is impossible; unless, indeed, this mythical *Eobasileus*, under the Professor's domestication, has changed its characters more rapidly than Darwin himself ever imagined for the most protean of species. Professor Cope has stated distinctly that this genus had upper incisors, but no canines; next, that it had canines, but no incisors; and finally, that it has one incisor and one canine. He has said, also, that the nasal bones were greatly elongated; and again, that they were very short; that the spine of the tibia was obtuse; and next that it was wanting. Strangest of all, he informs us that the frontal sinuses of *Eobasileus* are in the squamosal region, and that the premaxillary is a trenchant tusk! Surely, such an animal belongs in the Arabian Nights and not in the records of modern science.—
Yale College, Feb. 15, 1873.

EXPLANATION OF PLATES.

Plate I. *Dinoceras mirabilis* Marsh. Oblique view. One-fifth natural size.

Plate II. *Dinoceras mirabilis* Marsh. Figure 1, side view; figure 2, front view; figure 3, top view. All one-eighth natural size.

NOTES ON THE VEGETATION OF THE LOWER WABASH VALLEY.

BY ROBERT RIDGWAY.

III.—THE WOODS AND PRAIRIES OF THE UPLAND PORTIONS.

THE woods which extend back from the river bluffs toward the prairies are decidedly different in their character from those of the alluvial bottoms. The trees are of a lighter growth, though the timber is by no means small, and the species are fewer in number, while three or four kinds usually prevail largely over the others. The predominating trees are several species of oaks (*Quercus*) and hickories (*Carya*), the species of which vary according to the locality. The aspect of the undergrowth is yet more different, lacking entirely that rankness which the herbaceous plants attain in the bottom-lands, while it is more scant, and perhaps less varied. It often consists of merely a younger growth of the same species as the larger trees, this mixed with patches of hazel (*Corylus Americana*) and, more or less generally, with thickets of wild plum (*Prunus Americana*) and crab apple (*Pyrus coronaria*); the most conspicuous and prevalent herbaceous plants being the May apple (*Podophyllum peltatum*), Columbo (*Frasera Carolinensis*), and Indian turnip (*Arisæma triphyllum*). These, of course, are associated with a vast multitude of other plants, many of them equally striking, and often locally as prevalent, but they vary so much with the locality that we will not attempt to name them here. The comparative thinness of the undergrowth of these woods is easily explained by the dryness of the soil, which is owing both to its higher location and the different geological formation upon which it rests. In consequence of this, the ground is covered throughout the year with a deep deposit of dead leaves, which effectually suppresses the growth of a rank herbage. In the bottom-lands, on the contrary, the ground is continually wet, so that the fallen leaves rapidly decay, while their moist decomposition generates a heat peculiarly favorable to the very luxuriant growth of the herbaceous plants. The vines of these dry woods are, however, not less beautiful and luxuriant than those of the bottom-lands, for, with the exception of *Tecoma radicans*, *Bignonia*

capreolata, and several species of *Smilax*, which are usually absent here, they are of the same species; while the hop (*Humulus lupulus*), wild yam (*Dioscorea villosa*) and climbing rose (*Rosa setigera*), are decidedly characteristic of the dry woods.

The "Oak Openings" are a beautiful modification of these woods, and form a feature strikingly characteristic of the prairie regions of the Mississippi Valley; and nowhere are they more attractive than in southern Illinois. They are usually found in the region where the timber and prairie meet. Their most striking peculiarity is the symmetrical shape, uniform size and compact foliage, of the prairie oaks (different species, according to the locality, but usually the *Quercus imbricaria*, *Q. nigra* or, in damp situations, *Q. palustris*), which, almost exclusively, compose them, and especially the smoothness and fresh appearance of the clean, bright green sward beneath them. To do them justice, we cannot do better than quote from a very truthful description which we have lately read:—"They (the trees) rise from a grassy turf seldom encumbered with brushwood, but not unfrequently broken by jungles of rich and gaudy flowering plants, and of dwarf sumac. Among the oak openings you find some of the most lovely landscapes of the West, and travel for miles and miles through varied park scenery of natural growth, with all the diversity of gently swelling hill and dale; here, trees grouped or standing single—and there, arranged in long avenues, as if laid out by human hands, with slips of open meadow between them. Sometimes the openings are interrupted with numerous clear lakes, and with this addition become enchantingly beautiful." [Encyclopædia of Geography; Thos. E. Bradford, III, 562; 1840.] To this description, we can only add that when viewed from across a meadow, the groves present a symmetry in the trees, a uniformity in their size and shape, and a compactness and richness of foliage, never excelled, and seldom, if ever, equalled, in the best-kept artificial park. The lower branches of all the trees begin at a uniform level, and the space beneath is left perfectly free from brushwood or rubbish of any kind, so that under the straight line marking the lower limit of the foliage, there is seen only the well-shapen trunks, rising from a beautiful sward of the freshest green. The trees about the border are often beautifully canopied by a matted covering of wild grape, while the vines of this species, coiled or twisted into fantastic and artistic shapes, sometimes lend an additional beauty to the groves themselves.

The "Barrens" are sections covered with a scrubby wood of small but growing trees, their growth choked with a nearly impenetrable jungle of varied shrubbery. Comparatively few years ago they were all open grassy prairie, but as soon as the country became settled the young trees began to sprout up, until gradually they have become entirely clothed with thick young forest. Twenty years from now, they will have lost their present character, and become transformed into the usual woods of the region.*

Many former prairies of often ten miles or more in breadth are now entirely overgrown with a dense scrub of hazel (*Corylus Americana*), sumac (*Rhus* — several species), blackberry (*Rubus villosus*), wild plum (*Prunus Americana* and *P. chicasa?*), crab apple (*Pyrus coronaria*) "queen of the prairie" (*Spiræa lobata*), wild roses (*Rosa Carolina* and *R. setigera*) and other kindred shrubs, or small trees, among which spring up a more scattered growth of forest-trees, chiefly oaks (as the *Q. obtusiloba*, *Q. nigra*, and a variety of *Q. falcata*) and hickories. For floral display, no sections of the country are so beautiful as the "barrens." The crimson cones of the sumacs; the showy climbing rose (*Rosa setigera*), which ascends through the trees to their very tops; numerous flowering vines, among which the Leguminosæ and Caprifoliaceæ contribute each a variety of species; and the host of gaudy-flowered plants belonging to the Compositæ, which still linger as remnants of the prairie vegetation, produce not only a gaudy, but also a richly varied appearance, which is still further beautified by the lovely vine-canopies with which many of the trees are clothed.

The prairies which adjoin the forest region of the Wabash Valley are mostly of limited extent, being mere indentations into the timber, or "bays," of the larger ones toward the middle of the State. Most of them have now lost their primitive aspect, being either largely under cultivation or else trampled by herds of stock. According to the settlers it is now a rare, if a possible, thing, to find a prairie where the grass is as tall, the weeds as rank and coarse, and the flowers as showy, as they were twenty or thirty years ago. As they now are, a conspicuous feature in their flora is

* It is asserted by all the old settlers of the country, that there is now a far greater area of timber in this section than there was twenty, thirty, or even forty years ago, notwithstanding the fact that the timber is constantly cut for fencing, building and other purposes to which civilization sacrifices the forests. The encroachment of the woods upon the prairies goes rapidly and steadily on, and seems to supply new timber faster than the old is destroyed.

the frequent clumps of the *Hibiscus grandiflorus*, or great-flowered mallow, which grows along the banks of streams, the border of ponds, or other moist places. This plant occurs more or less abundantly on nearly all the prairies of Richland, Lawrence, Wabash and Edwards counties, and perhaps throughout the state south of latitude 38° 25′. It is one of the most conspicuous plants of the prairie, for when in bloom, its large, crimson-centred white flowers sometimes measure nearly a foot in expanse.

THE GIGANTIC MAMMALS OF THE GENUS EOBASILEUS.*

BY PROFESSOR E. D. COPE.

A genus closely allied to the Proboscidea called Bathmodon, was recently (February, 1872) described by the writer as represented by remains of the Eocene Formations of Wyoming Territory. Investigations prosecuted during the present season, in the same region, under the direction of Prof. F. V. Hayden's Geological Survey of the territories, have resulted in a better acquaintance with these forms, and an approximation to a true estimate of their affinities.

The present genus, which is new and may be called *Eobasileus*,† is proven to be quite distinct from *Bathmodon* in the dentition of the premaxillary bone. It is narrow and edentulous and separated from its fellow by a deep notch. The front of the maxillary bone supports a tusk which represents the canine. It is shorter than in the walrus, but longer than in the sabre toothed tigers, and resembles the canines of the latter in being compressed and sharp-edged in front and behind. A long edentulous space follows the canine, before the molars commence. These are of relatively small size, and number 4 – 2. They all exhibit a single crescentic crest with angle inwards; but becoming straighter on the anterior teeth, where they are little curved. There is a single tubercle within the crescent, which with wearing soon becomes

* Read at the Dubuque Meeting of the American Association for the Advancement of Science. 1872.

† Proceedings of the American Philosophical Society, 1872, p. 485 (August 20).

confluent with the crescent giving a V-shaped surface on the premolars, or later a triangular one.

The general form of the cranium is remarkable. The temporal fossæ are latero-posterior, and there is a transverse supraoccipital crest. The zygomatic arches are posterior and the orbits not enclosed behind, nor with marked superciliary ridges. The muzzle is compressed and roof-shaped, and the frontal bones extend far in advance of the tusks, and even beyond the extremity of the long premaxillaries, overhanging them still more than in the rhinoceros. The margins of their extremities are flared upwards forming bony projections like shovels. These may have supported dermal horns as in the rhinoceros. These are composed externally of the maxillary, and internally of the nasal bones. Add to these, horns with stout osseous cores, one above each orbit, with approximated bases, and the curious physiognomy of the form becomes apparent.

The general form is massive, the ilia are wide and capacious and the limb bones exceedingly stout. The great trochanter is flat and thick; the fibular condyle well developed, and the astragalus little convex. The tarsus and foot are Proboscidian in character, and the short thick phalanges indicate the massive foot of a land animal.

There are three species of this genus known to the writer. The *E. cornutus* is known from many parts of the skeleton, including a nearly perfect cranium. This cranium measures over three feet in length and is in very perfect condition. The tusk is projected about a foot from its projecting alveolus and is recurved and covered on the distal half with smooth enamel. The horn-cores are a foot long, very stout, trihedral at base and with an enlargement on the inner side. The nasal projections viewed from above give the end of the muzzle a bilobed outline. The diameter of the pelvis measured between the crests of the ilia is nearly five feet. The long diameter of the proximal end of the femur is about ten inches. A sacral vertebral centrum is five inches in transverse diameter.

A second species is represented by some portions of the frontal bones. In this one the elevated margin is prolonged into a spatuliform process with a flattened convex extremity. The muzzle of this species when viewed from above is therefore bifurcate, hence the species is called *Eobasileus furcatus*.

A species different from the *E. cornutus* is represented by numerous remains. The most characteristic are the horn-cores, which are compressed at the base, somewhat acuminate and without inner enlargement. This may be called *E. pressicornis.*

The general form was stout and heavy, and less elevated than in the existing elephants. With proportions somewhat as in the rhinoceros, the species *E. cornutus* was larger than in any known species of that genus, being quite equal to the mastodons in bulk.

This form will probably be found to be the predecessor in time of the huge forms of Proboscidians now known, and certain allies will be found to stand in the same relation to the odd and even-toed ungulates.

Remains of six of these huge quadrupeds were found in one locality in Southern Wyoming, and bones of at least twenty were found by the expedition.

Since the above was read at Dubuque it has been ascertained that the *E. pressicornis* and *E. furcatus* belong to the genus *Uintatherium*, having rudimental knobs instead of flat shovels on the nasal bones. This genus differs from *Eobasileus* in the rudimental character of the nasal horn-cores, and in the presence of an elevated lateral parietal crest. In *Eobasileus* the latter is almost wanting. They also differ in the character of the posterior (third) pair of horn-cores.

Subsequently, at a meeting of the Philadelphia Academy of Natural Sciences (January 14, 1873), the writer gave his reasons for regarding the genera *Eobasileus* and *Uintatherium* as Proboscidians constituting a peculiar family of the order, and his objections to referring them to a new order as has been proposed by Professor Marsh. He said he had first (August 20, 1872) *given reasons* for regarding them as *Proboscidea*, though Professor Marsh had previously referred one of them to *Mastodon* by name only. Some of the reasons are as follows:

1. The extreme shortness of the free extremity of the nasal bones.
2. The malar bone is rod-like, and forms the middle element of the zygomatic arch.
3. The cervical vertebræ are exceedingly short and transverse.
4. The radius crosses the ulna obliquely and leaves a large carpal surface to the latter beside it.
5. The femur is without third trochanter or fossa for the round ligament.
6. Its condyles are contracted and the intercondylar fossa is prolonged and fissure like.
7. The spine of the tibia is absent, and the glenoid cavities separated by a longitudinal keel.
8. The astragalus is not hour-glass shaped above, but with a uniform face.

9. The calcaneum is very short and largely inferior.
10. The phalanges represent several toes, and are very short and stout.

To these may be added three external characters, which directly result from the osteological, namely:

11. The possession of a proboscis. This is proven by the extreme shortness and stoutness of the free part of the nasal bones; by the very short cervical vertebræ, and by the fact that the nasal and premaxillary bones are deeply excavated at their extremities, with surrounding osseous eminences, for the origin of the muscles of the trunk.
12. The extension of the femur below the body, so that the leg was extended with the knee below and free from the body, as in elephants, monkeys and man.
13. The short subplantigrade foot, so different from the digitigrade character of other ungulates. The inferior surface of the calcaneum looks as though it furnished insertion for a ligamentous pad.

Other characters, common to *Proboscidea* and some other ungulates, are —

14. The scapula acuminate in outline above the spine, with a very short coracoid and alate spine.
15. Broad truncate occiput with widely separated temporal fossæ.
16. The greatly expanded iliac bones.

The presence of canine teeth and horns had been stated by Professor Marsh as characteristic of a new order. Neither of these were regarded by Professor Cope as sufficiently important for such an interpretation, since in Artiodactyles, and even in the Ruminant division, we have every variety of condition in both these points; *Moschidæ*, *Cephalophus* and *Hydropotes* were hornless, and some of these and some deer had canines. The wart hog has compound molars, no lower incisors and huge tusks. But the difference in this point from elephants he thought would disappear if, as was probable, the tusks of elephants should prove to be canines and not incisors. In these animals, as in *Eobasileus*, the tusk is enclosed between the maxillary and premaxillary, which is not the case with the outer incisors.

REVIEWS AND BOOK NOTICES.

The Geology of the Sea Bottom.*—This is a very important contribution to the study of the bottom of the seas which is now receiving so much attention. Intended at first to be limited to an examination of the sea bottom of the French coast, it was gradually

* A. Delesse. Lithologie des Mers de France et des Mers principales du globe. Paris. Dec., 1871. 2 vols. 8vo. pp. 479; 135: 3 pls., folio with cuts in text.

extended as far as the materials were accessible, such as the results of the deep sea soundings made by the Hydrographic bureaux of the European and American governments, to the principal seas of the globe. It is of course more complete for the seas borderring on France, yet it is a fair beginning of a subject which hitherto has received but little attention. The author has treated his materials with great success and has sketched out the broad outlines of a most fruitful line of inquiry.

It is the first systematic attempt made to classify the deposits now going on owing to the agencies at work on the surface of our earth; to show how unequally the deposits are made, how greatly the nature of these deposits and the existing topography are modified by the direction of the prevailing winds and oceanic currents, and more especially how materially the geology of the shores of the river basins, and of submerged rocks subject to the action of the waves, influences the mineralogical constituents of the deposits formed at any one point.

The maps which accompany this volume are the results of the most careful examination and analysis of the materials brought up by the lead, or thrown on the shores by the action of the waves, or resulting from the decomposition of the cliffs along the coast line, of the banks of the rivers forming the different hydrographic basins, from their source as they pass through the different geological formations to their mouth. The fate of the different mineralogical constituents is carefully followed and the effect each has upon the bottom of the sea into which the basin drains carefully noted.

The effect of the atmosphere in carrying dust in suspension, of the direction of the prevailing winds, especially on the seacoasts leading to the formation of dunes, and the effect produced by the unequal distribution of rain as an erosive agent in the different hydrographic basins are very accurately considered. The amount of material held in solution and suspension in the rivers of France is shown to be enormous and to depend of course mainly upon the geological composition of the rocks of the different hydrographic basins influencing, to a great extent, the condition of the navigation of the outlets of the larger rivers, and the formation and preservation of the harbors at the mouth of the navigable rivers. The power of transportation and erosion of fresh water and rain, as shown by the action of rivers, is slight compared to the action of the sea; the mechanical results produced by waves, by permanent

currents, by the tides and prevailing winds, are more varied of course than those of the rivers. The action of the sea extends over a great area and acting at a great depth is the most powerful agent in the rearrangement and final distribution of the materials brought down by the rivers.

The action of internal agents produced by eruptions, though undoubtedly very powerful, is unfortunately inaccessible and we can only guess at what might happen from a study of such phenomena as the submarine volcanoes of the Mediterranean, the Caspian sea, and remember that many of the phenomena which produce instant visible changes on the surface of the globe must be acting with equal or greater efficiency and as frequently on the bottom of the sea.

The agency of organisms in determining the constitutions of the bottom of the sea is only introduced as far as the action of the invertebrates of the coast of France can throw any light upon the subject, and no attempt has been made by the author to do more than point out, what is well known to all students of marine zoology, the correlation between the fauna and the physical structure of the coast. He indicates the dependence of special forms or certain floras upon a sandy or rocky bottom, or a gravelly shore, or the different features presented by a muddy shore. This is perhaps the most unsatisfactory part of the work, and it is a great pity that the description of the agency of animal life upon the formation of the sea bottom should have been limited to the comparatively uninfluential agencies at work at the present time on the coast of France, and that only slight allusion should have been made to the all-important part which corals now play in the fashioning of the sea bottom of so large a part of our globe.

The maps are admirably engraved and as far as they relate to France and Europe of great accuracy. A few unfortunate errors have crept in relating to the hydrography of the Hudson and Susquehanna rivers and the connection of the great Lakes, which are undoubtedly due to the want of supervision of a part of the work during the Prusso-French war. The map of the hydrographic basins of France is especially worthy of notice. He has completed the survey of the seas of the present time by a very successful attempt to restore and map out the ancient seas and general topography of France during the successive geological periods, and to give a succinct history of the changes which have

taken place to bring about the present topographical features of France.

The data from which the conclusions of Delesse have been drawn are carefully tabulated and published as an independent appendix to the general text. This work was nearly completed at the breaking out of the war, and the unavoidable delay occasioned will account for the absence of reference to much that has been done of late by the Scandinavian, American and English governments.

These matters of omissions are of slight importance, and we recommend this suggestive volume to all who are interested in the study of geology as deduced from agencies now at work on the surface of our globe.—A. Agassiz.

Handbook of British Birds.*—Justly observing, of several admirable works on British Ornithology, that "they do not distinguish with sufficient clearness the species which are truly indigenous to Great Britain from those which are but rare and accidental visitants; nor do they indicate with sufficient authority the scientific nomenclature which should be adopted"— the author undertakes to supply these deficiencies in a Handbook which is not "intended to rival or supplant existing or forthcoming text-books on the subject, but to assist students in a manner and to an extent which has not been contemplated in the works referred to." "The claims of species to rank as British, the proper scientific names which each should bear, the *habitat* of the rarer visitants, and the frequency or otherwise of their occurrence are points to which attention is almost exclusively directed." The author has thus had a definite plan of work, which has been unquestionably executed with fidelity and ability; and though we are not prepared to judge the accuracy of his statements in detail, we should say that they show intrinsic evidences of reliability, both from the author's evident familiarity with his theme, and from the obvious care with which he has compiled and digested the statistics of those observations which, in the nature of the case, he cannot have personally made or verified.

Following an introduction which contains much miscellaneous information besides a comprehensive survey of the matter in hand, comes a freely annotated list of the residents, migrants and annual

* A Handbook of British Birds showing the distribution of the resident and migratory species in the British Islands, with an Index to the Records of the Rarer Visitants. By J. E. Harting, F.L.S., F.Z.S., etc. etc. London. 1872. 8vo. pp. xxiv, 198.

visitants, with concise and precise statement of the part each plays in the bird fauna. These classes are found to embrace two hundred and sixty species, out of a total of three hundred and ninety-five recognized as British; the remaining one hundred and thirty-five, or rather more than one-third, being considered as "rare or accidental visitants." To these last, Part II of the work, no inconsiderable portion of the whole, is devoted, and we particularly admire the way these stragglers are handled. While the author is lavish of references throughout the work, citing his authority as a rule for all special occurrences, this portion of the volume is almost entirely composed of references to recorded cases of capture or observance of the species noted. For instance, twenty-four observed occurrences of the snowy owl are noted, each accompanied by a citation of the published record. Another portion of the work gives a nominal list of British birds, in which the indigenous species and the stragglers are printed in parallel columns. We do not see how more information of the sort that the author volunteers to supply could be brought within the same compass, nor what more convenient, and consequently useful, method could have been devised for holding up the whole subject in the strongest light.

For ourselves, we are naturally most interested in the cases of those North American birds which enter the list as stragglers.* The author enumerates over forty of them, a few however with doubt. "It is extremely difficult to believe," he continues, "that the non-aquatic species in this list have journeyed across the

* Following is the list, which some one without Dr. Harting's book at hand may find useful. The numbers in parentheses indicate the instances of observation or capture. —*Astur atricapillus* (3), *Nauclerus furcatus* (5), *Buteo lineatus* (1, doubtfully), *Scops asio* (2, doubtfully), *Nyctale Acadica* (0, doubtfully), *Vireosylvia olivacea* (1), *Regulus calendula* (1), *Anthus Ludovicianus* (9, doubtfully), *Loxia leucoptera* (4), *Agelæus phœniceus* (9), *Sturnella magna* (3), *Picus villosus* (2), *P. pubescens* (1), *P. auratus* (1), *Cuculus Americanus* (5), *C. erythrophthalmus* (1), *Ceryle alcyon* (2), *Hirundo purpurea* (2, doubtfully), *H. bicolor* (1), *Columba migratoria* (5), *Ortyx Virginianus* (introduced), *Ægialitis vociferus*, *Totanus flavipes* [each ?] (3), *T. solitarius* (1), *Actiturus Bartramius* (4), *Tryngites rufescens* (15), *Tringoides macularius* (16), *Tringa maculata* (16), *T. Bonapartii* (9), *T. pusilla* [of Wilson] (2), *Gallinago Wilsoni* (1), *Macrorhamphus griseus* (15), *Numenius borealis* (4), *Botaurus lentiginosus* (4), *Crex Carolina* (1), *Cygnus Americanus* (1), *C. buccinator* (1), *Anser albatus* (1), *Anas Americana* (6), *Clangula albeola* (5 or 6), *Œdemia perspicillata* (10), *Somateria spectabilis* (15), and *Mergus cucullatus* (11).

We wish that some of the continental quotations of American birds, notably those referring to Heligoland could be scrutinized as closely as Dr. Harting has the British ones.

It is an interesting question what proportion the *recorded* occurrences probably bear to the *actual* number of such instances of American stragglers.

Atlantic, and performed a voyage of at least seventeen hundred nautical miles on the shortest route, *via* Newfoundland; but that most of them have actually done so seems proved by the fact that they have never been met with in Greenland, Iceland, and the Faroe Isles, and many which have thus found their way to England or Ireland. . . have never been met with on any part of the European continent. As might be expected, at least half the American species found in this country belong to the orders *Grallatores* and *Natatores*, while of the fourteen species of Insessorial birds, none of them, with the exception of *Agelæus phœniceus*, has occurred half a dozen times. This plainly shows that their appearance on this side of the Atlantic is the merest accident and not the result of any continued and successful attempt at migration (p. xi)." In taking account of these and other stragglers, Dr. Harting makes some further remarks which are timely and judicious on the credibility of published records. While we speak in unqualified terms of the success we believe Dr. Harting has attained in all that relates to the principal one of his two aims, just noticed, we think it remains to be seen whether he has fixed the nomenclature of even the comparatively few species he treats, more stably than his predecessors in the same field. The plain truth is, we are all at sea now in this matter; for the simple reason that we may advise, or exhort, or even "legislate," yet have no means of making others mind what we say. A law is no law that binds only those who choose to be bound. If it be urged, that in such case an appeal to good sense should suffice, it might be replied (borrowing a simile from our author), that good sense is a "rare and accidental visitant" of average humanity, by no means "indigenous" even to ornithologists; and consequently can seldom be invoked with reasonable expectation of any tangible result.—E. C.

THE BIRDS OF FLORIDA.— The first part (4to, pp. 32) of Mr. C. J. Maynard's work, the "Birds of Florida," having come to hand, we are enabled to judge somewhat better of its scope and general character than we were able from the specimen pages sent out some time since with the prospectus. Fifteen species are described, carrying us through the families *Turdidæ*, *Saxicolidæ*, *Sylviidæ*, and nearly through the *Paridæ*. Though nominally a work on the birds of Florida, it embraces many biographical and other details based upon observations made in New England, thus giving quite

a full history of each species, instead of merely a sketch of its characteristics as seen in the "Land of flowers." This method will, of course, increase the value of the work to the general reader. The title * quite fully indicates its general character, as far as the more technical part is concerned, but the "notes on their habits" are really very satisfactory and concise biographical sketches, written in an exceedingly clear and pleasing style. With them are incidentally incorporated, as occasion offers, graphic and more or less extended delineations of the peculiar natural features of the country — of the Pine Barrens, the Everglades and the Keys. The matter is arranged under distinct heads, and the biographical part is further distinguished from the rest by being printed in larger type. The descriptions are well drawn, and unusual attention is paid to the different states of plumage depending upon age and sex. The work is thoroughly original, and almost every page contains some interesting fact relating to habits or particular phases of plumage not previously chronicled. The dimensions given are usually the average of a considerable series of specimens. While not wholly above criticism in respect to a few minor points, the work is not only an attractive one but a valuable contribution to ornithological literature. Its typographical execution is exceedingly neat, and the plates, judging from the specimen number, are very creditable productions.—J. A. A.

THE SCIOPTICON MANUAL.†—The appearance of a new and revised edition of this book gives occasion to say that both it and the apparatus which it describes will be found of great service to those who are desirous of illustrating optically (by diagrams, pictures and experiments) their scientific teaching, but who are shut off by their limited means from the purchase of the more expensive calcium and electric lanterns. For a class room or school laboratory, Mr. Marcy's Sciopticon will supply an excellent means of demonstration. It is likely that the use of the modern demonstrating lantern will continually increase the very brilliant results attained by Profs. Morton and Tyndall, being quite sufficient to

* The Birds of Florida, containing Original Descriptions of upwards of Two Hundred and Fifty Species, with Notes on their Habits, etc. By C. J. Maynard. With Five Plates, drawn and colored from Nature, by Helen S. Farley. Salem. Naturalists' Agency. 1872. Part I. 4to, pp. 32, and one plate. October, 1872.

† The Sciopticon Manual: explaining Marcy's New Magic Lantern and Light, including Magic Lantern Optics, Experiments, Photographing and Coloring Slides, etc., by L. J. Marcy, optician, 1340 Chestnut St., Philadelphia. Revised ed., 1872. Price 50 cents.

excite enthusiasm among all educators and lecturers. Mr. Marcy seems to have done the best that can be accomplished with coal oil as a source of light; and he constructs a very powerful lamp for this purpose, with this especial merit in its plan, that it has no chimney to be broken otherwise to annoy the operator. Besides the description and figures of the Sciopticon, the manual contains very full direction for experimenting, photographing and otherwise preparing slides, etc. One chapter is contributed by Prof. Henry Morton, the most successful American demonstrator and experimenter with the lantern.—E. C. B.

BOTANY.

THE HORSE DISEASE. — Referring to the communication in the February number (pp. 120–123), as Mr. Morehouse found that many of the organisms he represents were present in the air of the stable, he should now, when the disease has passed, as soon as possible expose similar glass slides to the same conditions, — so as to ascertain whether these organisms are not still there. Upon the result of this the whole importance of the observations depends.

While the pen is in hand, we beg to dissent from the idea that lichens are parasitic and have no chlorophyl (p. 67); and no less from the statement that the "plants are very few" which require the aid of insects to secure fertilization, and which attract them by their bright colors; and that most flowers could accomplish their destined purpose just as well were they clad in the drab of the veriest Quaker (p. 70). The young people who read "How Plants Behave" will know better. — A. G.

THE CRETACEOUS FLORA OF NORTH GREENLAND.—Among the interesting collections which the Swedish polar expedition of 1870 brought to Europe was a fine suite of fossil plants, collected at the desire of Dr. O. Heer, in Zürich, who in his "Flora Fossilis Arctica" proved that certain black shales at Kome, north of the peninsula Noursoak, belonged to the Cretaceous series. This is now conclusively proved. The specimens brought from Kome are forty-three in number, among which Dr. Heer recognizes *Filices*, *Rhizocarpeæ*, *Equisetaceæ*, *Cycadeæ*, *Coniferæ*, *Monocotyledones*, and *Dicotyledones*. The Ferns are very numerous, *Gleichenia* being peculiarly abundant. The *Cycadeæ* and *Coniferæ* are also repre-

sented by many species, among which *Podozamites Hohenеggeri* is notable, as likewise occurring in the Wernsdorf beds of the Northern Carpathians. Monocotyledons are rare, and only exist as fragments in the collection, while the Dicotyledons also are only represented by a few fragments of leaves, most probably belonging to *Populus*. Such a flora, with a preponderance of *Coniferæ*, *Cycadeæ*, and *Filices*, and *Gleichenia*, *Marattiaceæ*, *Dictophyllum*, and *Cycadeæ* in abundance, must be counted a subtropical one. To judge from the presence of *Podozamites Hoheneggeri*, and *Eolirion primigenium*, the deposit probably represents the Wernsdorf beds belonging to the Urgonien. This flora has a different climatic character from the Miocene flora of Greenland, in which respect it agrees with the Lower Cretaceous flora of Central Germany. Similar black shales have also been found at the south side of the Noursoak peninsula, near Atane, and at about eight hundred feet below the well-known Miocene bed. Here also the shales contain plants belonging to a higher horizon of the Cretaceous series. There are forty-five species known; among them being *Filices*, *Cycadeæ*, *Coniferæ*, *Monocotyledones*, and *Dicotyledones*. *Coniferæ* are again numerous, but Ferns are rare. Of *Monocotyledones* only a *Bambusium* and two other species are known. The difference between the Atane beds and those of Kome chiefly consists in the great preponderance of *Dicotyledones* in the latter, which, as in the Upper Cretaceous of Germany, are presented by great variety of types. A point of great interest is the discovery in these beds of a beautiful species of fig tree with leaves and fruit attached. In Central Europe *Dicotyledones* make their first appearance in the Cenomanien, and are very abundant in the Senonien near Aix-la-Chapelle. It is curious that both in Greenland and in Central Europe the *Dicotyledones* display a great variety of types in the Upper Cretaceous series, but are nearly wanting in the Lower Cretaceous. It seems to point to a great change having taken place in the flora between our latitude and 71° N. after the deposition of the Gault. ("Zeitschrift der deutschen geologischen Gesellschaft," part i, 155.)—*The Academy*.

Cultivated Wheat in a Bone Cave.—"The Bulletin de Académie royale des Sciences de Belgique," No. 7, contains a note by G. Dewalque announcing the discovery of wheat in a bone-cave in Namur. An exploration of this cave, which is near Jemelle,

was made by Professor Cousin, of Louvain, who found some bone implements, together with numbers of human bones. During a later visit more human bones, and a somewhat abundant quantity of wheat, were discovered in a stratum of angular flints. The wheat appeared to have been charred, and though it is decidedly smaller in size than our ordinary grain, the author does not hesitate to affirm that the material he has found is cultivated wheat. — *The Academy*.

ZOOLOGY.

THE SPIKE-HORNED MULEDEER.—My friend Mr. J. A. Allen, in a late number of the NATURALIST, calls in question the accuracy of my observation on an animal of the above character, believing that I have been deceived and have mistaken a two year old elk for a buck, *Cariacus macrotis*. Although I did not see the animal in the skin, my informants at Fort Hays were so well assured of its character that I accepted their statements. On a second inquiry of Dr. J. H. Janeway, Post Surgeon, he favored me with the following letter: —

"FORT HAYS, Kansas, Nov. 7, 1872.

Prof. E. D. COPE, *Philadelphia, Pa.* *My dear Sir*:—In regard to the spike-horns that I sent you, of which you so kindly acknowledged the receipt, and which seem to have caused some dispute as to their species: — I informed you that they were from a black tailed deer. Since then I have satisfied myself entirely that I was correct in the assertion. The buck was killed in company with a doe, about three miles southeast of this post and the meat was partaken of by my family and the families of other officers at the post and by patients in the hospital, and was recognized by all to be a "black tail deer." The skin, and especially the tail, were in possession of one of my sons for a long time and were known to him to belong to a black tail deer. No elk has been shot or seen at this post or this side of the Saline (over twelve miles distant, nearest point) inside of five years."

The association with a doe of the black-tailed species adds greatly to the probable correctness of the determination.

I have moreover examined a second example of spike-horn of this species, in possession of Mr. Prentice of Topeka, Kansas. The stuffed head which bears the horns belonged to a deer which was brought to the market in Leavenworth, Kansas, having been killed west of that city, towards the Republican river. The animal is evidently adult. The beam is twenty-two and one-fourth inches in length, fourteen inches in diameter at the base and sep-

arated three inches from its mate, at the base. It is thus not quite so long as the beam of the specimen first described. It differs moreover in possessing a peculiar curvature just beyond the point where the large anterior antler should have been given off (which exceeds the beam in *C. Virginianus*). The true beam is shortly sigmoidally twisted, and then pursues a more anterior direction than in the normal horn, or my spike-horn. The anterior antler is represented by a rudiment.—E. D. COPE.

DOES THE PELICAN FEED ITS YOUNG WITH ITS OWN BLOOD?—The supposed fable of the pelican feeding its young with its own blood may prove, after all, to have some foundation in fact, as a somewhat analogous circumstance has recently been observed in connection with the flamingo. A pair of these birds in the Zoological Gardens of London showed symptons of breeding, but laid no eggs. Some Cariamas, kept in the same aviary, have the habit of opening their mouths, bending back their heads and uttering a plaintive cry like young birds. In response to this, the flamingoes during the period referred to would frequently stand over the Cariamas and, with a gulp, raise up a reddish glutinous fluid from their throats and disgorge it over them, pouring it into their throats and even over their backs. This on examination proved to consist of blood corpuscles, in a glairy fluid, and mixed with crystals, supposed to be principally of salt. This, by Mr. Bartlett, the superintendent of the Gardens, is believed to be an addition to the usual food furnished by the parent flamingoes to their young, and perhaps analogous to the milky fluid supplied by pigeons under the same circumstances, and discharged from the thickened membrane of the crop.

A somewhat analogous, and still more curious, fact is furnished by the hornbill, an African bird with a huge bill, of which many species can be seen in our public museums. As is now known, the male bird is in the habit of walling up the female while seated on her nest in a hole of a tree, so as to imprison her completely, leaving only the head and neck exposed. He then fills his crop with fruit which becomes encased in a gelatinous envelope, secreted from its walls and the whole is then brought up in a mass and fed to the captive.— S. F. B.

NEST, EGGS AND BREEDING HABITS OF THE VERMILION FLYCATCHER (*Pyrocephalus rubineus* var. *Mexicanus*).—This bird is a common summer resident of the southern portions of Arizona,

where it arrives the latter part of March, or early in April, almost exclusively frequenting the wooded borders of streams. About the 20th of April the pairs begin to build their nest, which is placed on a fork of one of the smaller branches of a mezquite or cottonwood, usually ten to twenty feet from the ground. It is difficult to find on account of its small size, and is not easily preserved being a very shallow affair, and loosely constructed. One now lying before me is composed of a groundwork of tops of weeds and small dry willow twigs, to which are added a few small pieces of the soft inner bark of cottonwood, and some other plant fibres; the lining consists of fine hair and pigeon feathers. The eggs are usually three in number; at least, I have never found more. They aré of a very pale cream color, spotted and blotched with the shades of umber brown and lilac, the spots in most cases forming a ring round the larger end, though sometimes pretty evenly distributed over the whole surface; and in such cases the markings are usually smaller and paler. The dimensions of a set are as follows:—.70 by .51; .69 by .53; .68 by .52. The largest one of four sets measures .72 by .52; the smallest, .66 by. 53. The period of incubation is about two weeks; the male does not appear to take part in it. At least two broods are reared each season. The male is very noisy at this time, hovering in the air in the manner of a sparrow-hawk if he observes any unwelcome intruder near his nest; when much excited resembling a miniature turkey-gobbler, and presenting a comical appearance with his crest erect, every feather ruffled out, and his tail at right angles with his body, seemingly having hard work to keep his balance. Whilst on wing at such times he continually utters a shrill cry of alarm, something like the syllables "*ze-bri, ze-bri*" quickly repeated. On leaving the nest, the young are of a uniform ashy gray color. About the end of September the bird leaves for its winter home in Mexico.—LT. CHAS. BENDIRE, U. S. A., *Tucson, Arizona.—Communicated by Dr. Coues.*

DISTRIBUTION OF THE HELICIDÆ IN THE SANDWICH ISLANDS.—Mr. John T. Gulick has contributed to a recent number of "Nature," a very interesting and valuable addition to our knowledge of the geographical distribution and variation of species, in an account of the section of Helicidæ, known as Achatinellinæ, found in the Sandwich Islands. The family, of which the com-

mon snail is an example, is quite peculiar to this group of islands, and is characterized by the columella having a spiral twist, giving it the appearance of being armed with a lamellated tooth revolving within the shell. The singular fact is that most of the genera and all the species are restricted, not only to a single island, but to a very small area in the islands. In Oahu, an island sixty miles long and fifteen broad, there is the extraordinary number of one hundred and eighty-five species of Achatinellinæ, none of them (with scarcely an exception) found on any other of the islands and no species occupying a large proportion even of this area. Most of the species are confined to the forests of mountain regions; and where, as on Oahu and Maui, there are two regions of forests divided by several miles of grass country, the island is also divided into two sections, having but few, if any, species in common. On the island of Oahu, the two sections which occupy separate mountain ranges are divided into many minor sections in the following manner. From each side of the main range project mountain ranges, which separate deep valleys a mile or two in width. Each of these valleys is a subordinate section, having its own varieties, and, in many instances its own species, which are nowhere else. Nearly all the species of one genus, found on one mountain range, are connected by varieties presenting very minute gradations of form and color. Species of the same genus on different islands are not so completely connected by intermediate forms. The family is divided into two natural groups of genera. The first group consists of seven genera,—Achatinella, Bulimella, Helicterella, Portulina, Newcombia, Laminella and Auriculella; these are all arboreal in their habits, and are either sinistral, or both dextral and sinistral. The second group consists of three genera,—Amastra, Leptachatina and Carelia; these mostly live on the ground, and are dextral. Granting the hypothesis of evolution, Mr. Gulick is quite unable to account for these singular facts, and many others enumerated in his highly interesting paper, on the theory of the Survival of the Fittest, or any other theory that has yet been brought forward.—A. W. B.

Harlan's Hawk and the Mexican Cormorant.—Prof. Baird having expressed a desire to see the specimens designated in my "Catalogue of the Birds of Kansas" as "Harlan's Hawk" and the "Florida Cormorant," I sent them to him for examination. Mr.

Ridgway writes that "the Buteo is really *B. Harlani* and in a plumage not seen before." A description of this bird will be found in his monograph of the North American Raptores soon to be published. Of the Cormorant, he says that it "is not *Graculus Floridanus* but *G. Mexicanus!* — the first specimen obtained north of the Rio Grande!" This bird was taken four miles south of Lawrence, April 2d, 1872. My mistake in the determination of the species arose from the lack of other specimens with which to make comparison, and from the fact that the measurements of this single specimen exceeded those given in Baird's General Report, the stretch of wings, for instance, being full six inches greater. — FRANK H. SNOW, *Lawrence, Kansas, July* 5th, 1872.

NOTE ON THE DATES OF SOME OF PROFESSOR COPE'S RECENT PAPERS.—The "Proceedings of the American Philosophical Society," vol. xii, No. 89, just issued (February 6, 1873), contain several communications by Professor Cope on Vertebrate Fossils from Wyoming. There are several errors in the dates of these papers, bearing in the same direction as those which I have already pointed out, but fortunately many of these can readily be corrected. In the table of contents of this number, under the stated meeting, August 15, 1872, eight papers by Professor Cope are enumerated; and it might be inferred that they were read on that day. In fact, however, there was no meeting of the Society on the 15th, the regular August meeting having been held Friday, August 16th, at which three only of these papers were read by title, or entered on the records. At the next regular meeting, September 20, 1872, five papers by Professor Cope were announced, or read by title. But as now published in the "Proceedings," four of these purport to have been read September 19, 1872, when no meeting was held on that date. The actual publication of these papers, by distribution, is of course a distinct matter, and the evidence is conclusive that none of them were so published before October 29, 1872, and some of them not until long after.—O. C. MARSH.

THE SOUND PRODUCED BY THE DEATH'S HEAD MOTH.—Mr. H. N. Mosely has been investigating the cause of the peculiar cry produced by the Death's Head Moth, *Acherontia atropos*, and records the result in "Nature." A number of treatises have been written on the subject, from the time of Réaumur in 1734, the various writers attributing it to friction between the abdomen and

thorax, the expiration of air through the proboscis, special organs attached to the abdomen, vibrations of the thoracic rings, and vibrations of the wings in rapid motion. A very complete and ingenious series of experiments conducted by Mr. Mosely seem to place beyond doubt the conclusion that the sound is produced by the proboscis, the note being formed at a narrow slit-like opening at the base of the trunk, and being modified by passage through the proboscis, and by vibrations therein set up.—A. W. B.

Mode of Increase of the Long Bones.—A paper on this subject appears in the last part of the *Archives de Physiologie*, by MM. Philippeaux and Vulpian. The views generally adopted in regard to the mode of growth of the long bones, both in length and diameter, have been called in question by Wolff and Volkmann in papers recently published; and MM. Philippeaux and Vulpian's researches were undertaken with the object of ascertaining whether their objections are well founded. The doctrine supported by the authority of Duhamel, Hunter, and Flourens, and generally accepted, is that the long bones increase in length by additions to the extremities in the form of new layers between the shaft or diaphysis and the articular portion or epiphysis, while they become broader by the deposition of new bone in the periosteum on the outer surface of the bone. M. Wolff, on the other hand, maintains that the growth of bone is interstitial, and that each part of the bone takes part in the enlargement. He points to the persistence, during growth, of the position and relations of the peculiar and geometrically arranged trabeculæ of the cancellous texture constituting the head of the bone, which could hardly occur on Duhamel's theory. He denies Duhamel's statement that a ring surrounding the bone of a young animal comes by degrees to occupy the shaft of the bone, owing to absorption of the old bone and the superposition of new; but contends that the old bone is pressed inwards, and is certainly not absorbed. He further states that when wires are passed through both the epiphysis and two points of the diaphysis, the distance between the two latter augments just as much as the distance between the wire passing through the epiphysis and that through the diaphysis lying nearest to it. MM. Philippeaux and Vulpian oppose M. Wolff's statements. They state that rings encircling the bone, as well as metallio lamellæ, interposed between the periosteum and osseous tissue in young animals, do actually cut their way till they are free, or almost free, in the medullary

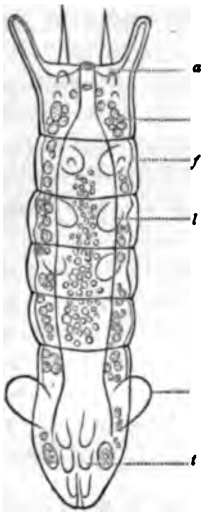
cavity; and they refer to specimens made by themselves in Flourens' laboratory, and now in the Musée Dupuytren, in confirmation of their theory. As regards the separation of metallic threads drilled into the bone, they think that in Wolff's experiments the two wires passed into the shaft of the bone were too near the epiphysis to furnish any satisfactory result. Finally, they give the details of a series of experiments conducted under Flourens' direction, in which madder was given to young pigs up to a certain period, when one of the litter was killed, and its bones prepared as objects of comparison with those of the rest, which were killed afterwards at stated intervals up to eighteen months. The bones of these animals, they declare, clearly demonstrate the correctness of the old doctrine, and prove irrefragably that all increase in diameter is due to fresh subperiostitic deposits, whilst all increase in length is caused by the progressive ossification of the osteological elements supplied by the cartilage of conjugation between the diaphysis and the epiphysis. Moreover their experiments incidentally showed that the long bones increase in length more at one extremity (the upper or proximal) than at the other.—*The Academy.*

MEADOW LARK WITH FOUR LEGS.—I have a Meadow lark (*Sturnella magna*), more than half grown, which possesses four legs. It lived about a week after capture, and for a time made use of all four. The extra or hinder pair is a little shorter than the front, and slenderer. One of them has all the toes well formed; the other has three delicate front toes, and instead of a hind one, a small appendage half way up the tarsus. Their femurs are attached to the end of the coccyx. This necessitated a one-sided position of the tail. There are two cloacæ, one on each side of the rump. This proves, as Vrolik has remarked, that in heteradelphs there are always the rudiments of two bodies. The front pair of legs, the wings, and all other parts are well developed.—JAMES ORTON.

WHEN IS SEX DETERMINED?—The interesting and able essay of Mrs. Treat that we give our readers in this number contains some interesting facts which are supposed by her to bear on this matter. We may, however, give some data which tend to show that the sex of the future insect, and probably of all animals, that reproduce by eggs, is determined at or about the time of conception or at least early in the embryonic state.

"Herold* it was, says Weismann, in his great work on the 'Development of the Diptera,' who first showed as regards the Lepidoptera that even in the egg, the germ of the sexual glands was formed, and when indeed the difference between the sexes is easily perceived. In the flies the same holds good, though indeed the differences between the germs of the female and male sexual glands are less striking to the eye. . . . That the sexual glands are formed in the egg results from their position in the midst of the fatty body, when they are cut off from any connection with parts to which they could owe their origin. The youngest larva in which I saw them was a centimetre (about four-tenths of an inch) long, and about five days old. With much expense of time it would be plainly possible to discover them even in the larva freshly excluded from the egg." (Die Entwicklung der Dipteren, p. 133.)

Fig. 33.



We may also cite the case of the larva of Polynema figured by Ganin (see this journal, vol. v. pp. 47, 48). As seen in the adjoining cut (Fig. 33) the rudiments (imaginal disks, *t*) of the ovipositor of the female are indicated at the same time as those of the legs (*l*) and wings(*f*) of the adult ichneumon fly.

In Platygaster, Ganin says, "the earliest indication of the sexual glands appears, as we shall see below, during the time when the first larval form passes into the second. With the first indication of the ovary that of the seminal glands agrees in all its relations. Both appear as small roundish structures arising out of the embryonal cells. For a long time (in the course of all the larval stages) these germs of the sexual organs remain in an unorganized state." It should be remembered, however, that the first larval stage of this egg-parasite which lives in the body of the larvæ of all gall flies (Cecidomyia) is not a true larva in the usual sense of the word, like that of the fly; it is an embryo set loose from the egg with organs not homologous with those of the fully

*Entwicklungsgeschichte der Schmetterlinge. 1815.

formed larva, having no organs of respiration (tracheæ), no completely organized alimentary canal, nor any vascular system. When compared with the freshly hatched larva of the fly or bee, it represents an early embryonic stage of the latter, and thus we feel warranted in supposing that in the bee, the difference between the sexes appears early in its embryonic life.

In these cases we may observe that the external surroundings and food of the larva seem to be identical.

In the larva of the humble bee when about half grown, if our memory is not at fault, we have observed the rudiments of the ovipositor of the female, and the corresponding external male organs. In the fully grown larva they are easily seen.

In forming an opinion on this question, it should be borne in mind that the sex of the honey bee is decided at the time the egg is laid, as it is well known that the unfertilized eggs of the queen produce females (workers and queens), while the eggs destined to hatch drones are fertilized by the queen *at her will*, since she relaxes the muscles guarding the opening of the spermatheca, allowing the spermatozoa to escape and impregnate the egg when she wishes to lay a drone egg. Thus from the researches of Dzierzon and von Siebold, it is a matter of fact that the sex of the honey bee is decided at the time the egg leaves the oviduct.

How early sex is determined in other classes of the animal kingdom would be a most interesting subject of investigation. We believe that the subject has been the most thoroughly discussed by those who have studied the embryology of insects. In man the sexes can be distinguished towards the end of the second month of fœtal life, according to Kölliker.* — A. S. P.

A New Species of Butterfly from Florida. — Key West abounds in lepidopterous insects even in winter. The southern section of the island is covered with luxuriant vegetation, among which spots have been cleared for plantations. Many of these have been abandoned and allowed to grow up to weeds and shrubs which are generally covered with flowers. These old fields are, on this account, the favorite resort of many butterflies and I have caught several species there in a few moments.

The shores are also open and many flowering plants may be found there. An immense number of butterflies are always

* Entwicklungsgeschichte des Menschen und der hoheren Thiere. 1861.

hovering over them during the day, and towards evening they all collect on the shrubs, or small trees, in groups of from ten to fifty. They will select the leeward side of the tree and alighting upon the leaves hang wings downwards; remaining in this position if undisturbed through the night. They are exceedingly stupid when thus roosting and I have taken as many as thirty with a single sweep of my net. Each group will be composed of a single species, but there are three kinds which usually gather in this manner, viz: — *Danais berenice*, *Agraulis vanillæ* and *Pieris monusta*.

The paths through the scrub are good collecting grounds for the smaller ones (*Thecla*, *Lycæna*, etc.), and I captured many of them. Among these I found a species of Lycæna which I think undescribed. It is of plain color and retiring habit, frequenting the edges of the bushes, generally keeping in the shade of the foliage. On this account I propose to name it the modest Lycæna (*Lycæna modesta*). The following is a description of this butterfly.

Above ashy-brown; darkest on the outer edges of the primaries, and becoming pearly on the secondaries. There are two triangular spots of black on the outer margins of the latter, and indications of a third. These are preceded on the outer edge by a band of black, which is slightly margined with white. Tail black. Under side ashy with a band of nearly confluent spots near the outer edges, which are edged with white on the outer sides. There is a narrow black line on the margin of the wings, preceded by ashy. Between the bar and line there are a few dusky triangles. also a few dusky spots near the costal border. A few black spots edged with white on the secondaries near the body. These are preceded by a bar of partly confluent black spots, margined on the outer side with white. Then come two bars of dusky spots edged with white on the inner side. The wing is terminated with an ashy line, which is preceded by a bar of black, edged on the inner side with white. There is a crescent of red near the middle of the outer side which encloses a black spot. On the lower angle is a black spot preceded with reddish. Body ashy; antennæ black, tipped with reddish-brown. Expands about one inch. — C. J. Maynard.

The Ribbon Seal of Alaska. — This species of seal (*Phoca fasciata* Shaw or *P. equestris* Pallas) is found in the waters of

northern Alaska, and is, so far as known, only represented well in the museum of St. Petersburg. In the Smithsonian collection, there are two skins, obtained by Dr. Dall from Cape Romanzoff, but no skull or other parts of the skeleton. The species is remarkable for color as well as for structural peculiarities. The male is at once recognizable by the color; this may be said to be a chocolate-brown except (1) a band of whitish-yellow, bent forwards towards the crown around the neck (2) an oval ring of the same color on each side, encircling the fore feet, and passing in front just before them, and (3) another band, also bent forwards above, behind the middle of the trunk. There is considerable variation in the extent of these bands, and sometimes the peribrachial rings are more or less confluent with the posterior band. The females are simply whitish-yellow, or have very indistinct traces of the postmedian band (fide Von Schrenck).

The structural (and especially dental) characters of this species, according to Von Schrenck, indicate a generic distinction from all the familiar forms of the subfamily *Phocinæ*. The molars (except the first) are two-rooted as in the typical *Phocinæ*, but in external form are simply conic or have rudimentary cusps, thus resembling Halichœrus. The genus may be named *Histriophoca*.

The special object of this communication is to call the attention of travellers in Alaska to the species, and skeletons (especially skulls) and skins are earnestly asked for. The species has been found also in Kamtschatka, and at the mouth of the Kamtschatka river in March and April, arriving there later than the other seals named.

One of the skins in the Smithsonian collection has been peeled off from the animal almost entire, and by a cross slit below and between the fore feet, and, being tied in front, has evidently been used as a bag. — T. Gill.

GEOLOGY.

Fossil Quadrumana in the Eocene of Wyoming. — An examination of more complete specimens of some of the extinct mammals already described by the writer from the Eocene deposits of the Rocky Mountain region, clearly indicate that among them are several representatives of the lower Quadrumana. Although these remains differ widely from all known forms of that group, their more important characters show that they should be placed with

them. The genera *Limnotherium*, *Thinolestes*, and *Telmatolestes*, especially, have the principal parts of the skeleton much as in some of the Lemurs, the correspondence in many of the larger bones being very close. The anterior part of the lower jaws is similar to that of the Marmosets, but the angle is more produced downward, and much inflected. The teeth are more numerous than in any known Quadrumana. Some of the species have apparently forty teeth, arranged as follows: Incisors $\frac{2}{2}$? canines $\frac{1}{1}$, premolars and molars $\frac{7}{7}$. A full description of these interesting remains, the first of the order detected in this country, will be given by the writer at an early day. — O. C. MARSH, *in the American Journal of Science and Arts, Vol. IV, Nov.*, 1872.

THE EOBASILEUS AGAIN. — I have just received a paper "On the Gigantic Fossil Mammals of the Order Dinocerata, by Prof. O. C. Marsh," which contains a formidable catalogue of errors which the author appears to suppose I have committed in describing animals of this type. All this is explained by the fact that Prof. Marsh has never seen the genus *Eobasileus* Cope, and erroneously supposes it to resemble *Uintatherium* Leidy (*Dinoceras* Marsh.) The descriptions which I have given are correct, as will presently appear, as well as the fact that I have anticipated the Professor in the description of some of the allied species. — E. D. COPE, *January* 31*st*, 1873.

ANTHROPOLOGY.

ARE THEY TWISTING STONES? — Associated with the various forms of stone implements and weapons found upon the surface of the fields in New Jersey are certain flat, quadrangular plates of stone of varying density, having one, two or more holes drilled through them. The outlines of these stone plates vary considerably, as may be seen by the reference to the drawings of seventeen specimens given by Squier and Davis, in "Ancient Monuments of the Mississippi Valley," p. 237, Fig. 136; and the position of the holes will also be seen to vary to a considerable extent. Of the two-holed specimens found by the writer, in the neighborhood of Trenton, N. J., the majority are about six inches in length by one and one-half inches in breadth; and the perforations are in most instances about an inch from either end. Such specimens as these are by many archæologists considered "twisting stones,"

or "for condensing the raw hide or sinews used as bowstrings." We have, however, looked upon them as "breast plates;" using that term not to designate a protective covering, but as an ornament that was suspended by a cord so as to rest upon the breast; or by the perforations, sewed or fastened securely to the skin mantle of the red man.

We have considered this to be the case, because in the "surface" burials—that is, graves originally on the surface, and now but little beneath it—which we have frequently discovered, we have found these perforated stones, of various shapes, lying upon the strip of black mould which once was a human body, *always* in such a position as to show that, whatever the object's use, it was placed upon the breast of the dead man, when the burial took place, or was one of the ornaments about him during life, and so was buried with him; and it seems strange, that if such a stone had been used solely as a "twister," that it should be placed upon the breast, instead of at the feet where the domestic implements are found, or at the right side, where we find the arrowheads, an axe or two, spears, knives and lanceheads.

Very many of these perforated stone relics, too, have but a single hole drilled through them, and being of such small size, and variously outlined, it is no stretch of the imagination to set them down as ornaments for suspension from the nose and ears. These single-holed specimens run into the others, as it were, just as the spear and lancehead are but large arrowpoints. Again, there are other specimens of this class of relics, which have more than two holes, sometimes as many as seven; as though the stone had been drilled again, when coming into the possession of another. At the ends of these many-holed specimens particularly, there is often found a series of well-cut notches, too small and closely set for any special use; but it seems to us very suggestive of a record that the owner of the stone has kept; and if so, the use of the stone as an ornament, worn at the breast, becomes the more probable, the specimen having additional value given it by the record, if such it was, that is engraved upon its margin.

Mr. Evans, in his work, "Ancient Stone Implements of Great Britain," figures, on pages 380-1, specimens allied to those we have described, but having the holes drilled in pairs, at each end. They differ further from the American forms, by being usually "round on one face and hollow on the other;" while as a rule, at least in

New Jersey, they are flat upon each side, with more or less bevelling of the edges.

With reference to the use of these plates, Mr. Evans quotes Rev. Canon Ingram, as suggesting "that these British plates were bracers or guards, to protect the left arm of the wearer against the blow of the string in shooting with the bow." Had this been one of the uses to which some of the American forms had been put, would it not have been retained by the Indians until now? And does any tribe of our aborigines use such a guard when hunting or fighting with the bow? There seems to be much reason, indeed, to believe that these plates were "bracers," in England, and it may be that many of the American forms were used in twisting cord and in condensing sinew; but as we have found so many in graves, in the position we have described, we cannot but think that the vast majority were merely for ornamental purposes. — CHARLES C. ABBOTT, M.D.

COLLECTIONS OF SWISS LACUSTRINE RELICS. — The present notice is written for the benefit of gentlemen interested in prehistoric archæology, who may be desirous of acquiring a collection of relics from the ancient lake-dwellings of Switzerland. I obtained myself a pretty good series of those objects through Mr. Jacob Messikommer, the well known owner and explorer of the celebrated pile-work of Robenhausen, on the shore of Lake Pfäffikon, Canton of Zürich. This lake formerly extended farther inland, and the site of the lake-village is at present occupied by a formation of peat, containing a great variety of relics which illustrate the curious phase of existence of those lake-dwelling people. Among the objects in my collection I will mention stag's horn in a natural or worked state, frequently made into sockets for holding hatchets; bone awls and chisel-like instruments; saws, cutting implements, scrapers, arrow and spearheads of flint; stone axes and chisels, crushing-stones, whetstones; pieces exhibiting the method employed in sawing and splitting stone for making axes, etc.; pottery, plain and ornamented, in fragments and in the shape of complete vessels; articles of wood, such as floaters for nets, twirling-sticks, etc. Of particular interest are the specimens of cloth, woven from flax, and perfectly preserved, owing to the carbonized state in which they occur. In the same condition are the numerous vegetable remains found in the peat around the piles. The most im-

portant, of course, are those that served as food; for instance, ears of wheat and barley, and agglomerations or lumps of grains of these cereals. Millet was likewise found, but no rye. Even pieces of wheat-bread, in which the grains can be plainly seen, have been preserved. There are small apples cut in halves, hazel-nuts, beechnuts, raspberry-seeds, stones of the wild plum, and other eatable productions of the vegetable kingdom. Flax sometimes occurs in fibres already prepared for spinning.

The fauna of that period is represented by a great number of animals, the osseous remains of which Mr. Messikommer obtains in large quantities from the peat. Some of these animals differ from the species now existing. The bones found at Robenhausen are always examined and classified by Professor Rütimeyer, one of the best osteologists of our time. The pile-work in question belongs to that remote period in which the use of metals was not yet known, and articles of bronze, therefore, are not found at this place. Mr. Messikommer, however, is in constant communication with the archæologists of Switzerland, and is thus enabled to procure by exchange the objects of bronze occurring in the Palafittes of later periods. He informed me some time ago that he is now prepared to furnish the typical objects of bronze, such as arrow and spearheads, knives, sickles, fish-hooks, ornaments, etc. His prices, of course, vary according to the character and condition of the specimens; but I can state from personal experience that they are low, considering the great labor and time it requires to obtain these remarkable tokens of the past. Mr. Messikommer is a gentleman of well established character, and the objects offered by him may be relied upon as being perfectly genuine. I will with pleasure give more detailed information to collectors who wish to enter into communication with Mr. Messikommer.—Charles Rau, *New York, February*, 1873.

MICROSCOPY.

Sections of the Organs of Hearing.—The following hints, abstracted from the papers of Mr. H. N. Moseley and Dr. U. Pritchard in the "Quarterly Journal of Microscopical Science," will be of use to beginners, not only in preparing the organ referred to, but in dealing with many cases involving some of the same difficulties. A guinea-pig is the most desirable subject, though the cat, dog, rabbit, rat, or other animals may be used. The ani-

mal is killed, the head removed, the lower jaw disarticulated, and the two tympanic bullæ exposed. One of these is opened and the cochlea, projecting into its cavity, removed and immersed in a half per cent. solution of chromic acid in water. The acid should be changed twice a week, and in about two weeks the soft tissues will be sufficiently hardened, and the bony parts may be softened enough for slicing with a razor. If not, one two-hundredth part of nitric or muriatic acid is to be added to the solution, and in from one day to three weeks, according to the hardness of the bone, the sections can be made. To support the internal parts while cutting, the cavity must be filled up. For this purpose inject the cavity with a hot solution of gelatine; or immerse it in a mixture of wax and cocoa butter melted together, and exhaust the air under a receiver of an air pump so that the melted wax can run in; or soak it, for an hour or two, in a thick solution of gum arabic contained in a paper bag, and then put the bag in absolute alcohol for a day or two when the water will be sufficiently extracted to leave the gum in a tough state (methylated spirit may be substituted for the absolute alcohol). The whole organ thus prepared is to be imbedded in the mixture of wax and cocoa butter,—or wax and sweet oil,—or lard one part, spermaceti two parts, and paraffine five parts, melted together over a water bath,—and sections cut with a very sharp razor. The sections are to be floated off, stained with carmine, and mounted in glycerine or in acetate of potash (acetate of potash two ounces, hot water one ounce, dissolve and cool; add spirits of camphor thirty drops, and filter); or transferred through water, absolute alcohol, and oil of cloves to dammar varnish or Canada balsam.

PROBABLE NATURE OF THE NERVE CURRENT.—Dr. L. S. Beale discusses this question in the "Monthly Microscopical Journal," and furnishes some very interesting speculations which are especially valuable from the author's eminent familiarity with the subject.

The active part of the nerve fibre distributed to the peripheral organ which receives the impressions is described as consisting invariably of a pale, very transparent, faintly granular, but in the natural state perfectly invisible cord. Between this and the central origin, in man and the higher animals, intervenes a more or less extended system of nerve cords through which impressions

pass with great rapidity. The part of these nerve cords capable of transmitting nervous impressions is generally conceded to be the axis cylinder, a thin, thread-like cord of extremely simple structure, never resembling the terminal network, and always surrounded by the medullary sheath, a white, fatty, albuminous substance of at least ten times its diameter, which seems calculated to insulate and protect it. This medullary sheath, or white substance of Schwann, is also little permeable to aqueous or albuminous solutions, and would preserve a uniform degree of moisture in the axis cylinder. The axis cylinder seems almost like an elongated band of white fibrous tissue. But little structural peculiarity has been demonstrated in it, and it is probably most remarkable for the perfect continuity of its parallel strata. The author believes that whatever changes take place in it might occur in other forms of tissue; indeed that such changes do occur in all tissues, but that only here are they so insulated that their variations become evident. If the axis cylinder could be replaced by a long filament of ordinary fibrous tissue, he would feel almost justified in expecting the nerve current to be as well conducted as by the axis cylinder itself.

That the nerve current is some unknown form of energy, different from heat, electricity, etc., but correlated with them, is mentioned as the prevalent belief of physiologists. It is deemed unphilosophical to explain phenomena by some conjectural force rather than by those we know something about; and the excellent opportunity for the author's favorite tilt at the physicists is taken advantage of with undisguised enthusiasm.

The chemical theory of the nerve current is still less admissible. The axis cylinder is a firm, tough, fibrous-like band, evidently of slow growth, little prone to rapid change, and only in imagination capable of rapid disintegration and reconstruction. Its action cannot be performed by chemical decomposition of its particles, especially as it is surrounded by ten times its thickness of myelin (medullary sheath) one of the least permeable substances in the body, and one of the least suitable media through which to take up new material or get rid of products of decay.

The vibratory theory is equally inconsistent with the structure of the axis cylinder, which is not well calculated to propagate motor impulses and which varies greatly in different parts of its course. The thickness of the medullary sheath, and its greater

development where nerves run parallel to one another are mentioned by the author as incompatible with this theory; though it is not inconceivable that such insulation should be as essential to other vibrations as to electrical movements.

That nerve fibre is a peculiarly vital form of tissue, pervaded by some exceptional form of force nowhere else present, seems entirely to want confirmation.

That the nerve current is ordinary electricity, transmitted through the beautifully insulated axis cylinder, though not proved, is considered more than probable, notwithstanding the somewhat incongruous result obtained by rough experiments, such as transmitting more powerful currents through mutilated nerves, or through nerves and other tissues after the post mortem changes, or at a rate slower than through copper wire, no allowance being made for the less perfect conducting power of a moist fibrous cord. No one has disproved the electrical character of the nerve current, while such character is strongly supported by a multitude of well determined facts, especially those connected with the electrical organs of some of the lower animals, where electricity is set free in special organs rich in nerves but not essentially different from other nerve organs.

How the course of the electrical current is directed and varied, and how subjected to the control of the will, are independent questions not yet answered.

Insects' Feet as Carriers of Dirt. — Prof. W. Kletzinsky, of Vienna, has detected with the microscope an abundance of foreign particles in pure glycerine into which flies had stepped and from which they had succeeded in freeing themselves; thus vindicating the belief that flies may become carriers of contagious diseases.

Circulation in Insects. — Mr. R. King read an interesting paper on this subject at the Dubuque meeting of the American Association. By a microscopical study of insects during periods of dormancy or hibernation, some forms of larvæ, especially, being so transparent that the microscope gains a perfect view of their internal organs without interfering with them, he is satisfied that there is no circulation while the insect is at absolute rest, and that the ordinary circulation in insects is entirely the result of the voluntary muscular activity of the creatures.

THE WHITE BLOOD-CORPUSCLES A CONNECTING LINK. — The "closing address" before the Oldham Microscopical Society, by its retiring President, Mr. James Nield, alludes to the white corpuscles of human blood, their chemical composition, their ever changing form, their use in the economy of the body, and their nearly complete identity in form and chemical composition with the corresponding corpuscles in the blood of all the other vertebrate animals. He admits the conviction that these peculiar bodies are links connecting the humble rhizopods with the highest animals, in the former case floating in water and in the latter drifting in the plasma of the blood. He considers the naked amæba and the sarcode of the foraminiferous shell only free members of a family which are aggregated and communistic in the higher creatures fiom the sponge to man.

MARKINGS OF BATTLEDOOR SCALES. — Mr. T. W. Wonfer assured the Brighton and Sussex Natural History Society that while examining these scales with reference to Dr. Anthony's idea that the markings were tubercles on the ribs, he succeeded in obtaining a view of some scales standing on edge, in which cases he could see the tubercles standing out distinctly from the ribs. The scales should be examined from freshly killed insects, as they tend to become flattened in drying.

STRUCTURE OF INFUSORIA. — Prof. Edward Van Beneden questions the pleuricellular nature of the Infusoria. The belief that they were unicellular beings was generally abandoned as soon as their complex nature became known; but he has found the Gregarinæ, monocellular organisms, to attain a high degree of complication, and he conceives that the same may be true of the Infusoria.

THE GONIOMETER STAGE. — The glass sliding-stage, moving upon a circular plate having concentric and graduated rotation, has become, and is still more becoming, so important a contrivance in microscopy that its origin is a question of some importance. This stage seems to be known in Europe as Nachet's invention, and it was doubtless from his new style of Students' Microscope that it was adopted by the London makers. Mr. Joseph Zentmayer of Philadelphia, who had made the plain glass stage long before that time, constructed in the spring of 1859, for a Mr. Rosevelt of New York, a revolving glass stage which would be

minutely and quite accurately represented by Dr. Carpenter's description (The Microscope, London, 1868, pp. 68 and 69). He continued to make these stages, and in the year 1864 furnished one to Prof. Edwin Emerson, then of Paris, who took pains to show the American stand to those interested in microscopes and especially to the makers. In October of the same year Mr. (now Dr.) W. W. Keen of Philadelphia exhibited one of these stands, with a similar stage, to Nachet, and the following spring placed it in his hands for safe packing for return to this country. These goniometer stages were certainly substantially the same as those now made, and were probably equal to any of the latter in delicacy of adjustment and finish; and it would seem that the publicity then given to them should guarantee to their maker the credit for their invention, unless some other person should claim to have arranged, and in some way published, an identical contrivance at an earlier date.

NOTES.

In the construction of new cases for the birds in the museum of the Boston Society of Natural History, we learn from the report of the custodian, Prof. Hyatt, "that extraordinary precautions were taken in order to render these cases absolutely insect-tight. The lumber was very carefully selected and kept heated while the work was going on, all joints were tongued, grooved and glued. The tops, bottoms and sides, were built into the plastering, the sashes grooved and tongued and locked by wedge-shaped bolts. The latter were invented in order to draw the sashes up tightly and firmly against the tongues at the top and bottom, and completely close the fronts of each case. Morse's patent brackets were used to suspend the shelving, which hangs upon the wall, and has no connection with the fronts. The success of these precautions is shown by the air-tight condition of the cases. By suddenly opening or closing a sash, one could readily crush in, or burst out, the neighboring glass panes. The resistance of the air is so great that it has to be overcome by a steady slow pressure as if one was working the handle of a piston. With the exception of the method of bolting, and some other details, this plan is similar to that which has been successfully adopted by the Smithsonian Institution for the preservation of their valuable collection of birds, and was recommended to us by Professor Baird.

"The entire collection of Coleoptera has been placed in insect-proof boxes by Mr. Sprague, and he has begun to secure the Harris collection in a similar manner. I desire, however, to call the attention of the society to the boxes upon the table. These are experiments upon the methods of mounting and illustrating the typical collection of insects, and will probably be adopted throughout that department. The difficulties that were overcome, and amount of study and labor expended by Mr. Sprague in making these pattern boxes, can only be rightly appreciated by those who have watched their progress. One of them exhibits the ventral and dorsal aspects of a large beetle, showing all the parts appropriately named. This is to be the type of the order. The other boxes contain the types of several genera and two families. The enlarged outlines of these small insects are given from the dorsal and ventral sides, accompanied by specimens having a similar position. On the right hand side of the box in each case are the characteristic parts, likewise greatly enlarged, so as to be readily seen, but each figure accompanied by its corresponding dissection. The characteristics of the family and genus are written opposite, so that the visitor sees at one glance the animal, its parts, and the family and generic characteristics. The outlines are drawn with the camera lucida, and corrected by the most careful study, so that they are as accurate as it is possible to make them."

Prof. Shaler of Harvard College at the last meeting of the American Educational Association followed with an address upon "The Method of Teaching Natural History." This, he said, as practised by him, embodied the same leading principles as had just been suggested by Prof. Pickering, the aim being to give the student a practical quite as much as a theoretical knowledge of the science. No text-book served as the basis of teaching, as it was quite insufficient for thorough instruction. A student in the first course is directed as his first lesson to go forth into nature and catch some kind of a living creature for study. It was no matter what he caught, whether a fly, a bird or a serpent. Having made a capture, the student is told to observe the creature and note down his observations. No matter what he observes, nothing can be too trivial, the point being to teach him to use his eyes. His notes are reviewed by the teacher, and appropriate comment and suggestion made with regard to further inquiry. It was a trait of

human nature that the study of dead things is at first repugnant to us. Living things are always interesting. The student accordingly begins with these, and this experience has almost invariably the effect to awaken his genuine interest or enthusiasm in the phenomena of nature. This is the second point gained. With this his attention can be fastened upon dead specimens, and the laws of organization as ascertained through these can be taught. Following upon this the practice was to take up some one of the great sequences of nature as observable in the animal kingdom; such as is given by the series of the actinoid polypes. The highest class had during the past year gone through with a course holding up to view what is known upon the most pressing question of the times, namely, the origin of the human species. The essential features of this method was first brought into use in this country by Agassiz, the only changes being such as were required to make it applicable to large numbers of students and to extend it to a course of several years of required work in the university.

The London "Journal of Botany" for January contains an interesting biographical sketch of Friedrich Welwitsch, the eminent botanist and discoverer of the singular plant which bears his name. He was born in Germany in 1807, but spent a portion of his life in the employment of the Portuguese government as superintendent of various gardens, while he paid much attention to the fungi and algæ, especially of Portugal. But his chief work was in elaborating the immense collections of plants made in the interior of Africa during a series of journeys which lasted seven years. "It was during his residence at Sange that Dr. Welwitsch made the acquaintance of Dr. Livingstone, then (October, 1854) on his way to Loanda, having travelled the whole distance from Cape Town. The two travellers lived together for some time, and the meeting had the effect of determining Dr. Welwitsch on relinquishing an idea he had previously entertained of endeavoring to make his way across the continent to the Portuguese possessions on the east coast — a task which, as is well known, Livingstone successfully accomplished during the two following years." As the result of these difficult and dangerous journeys he formed the best and most extensive herbarium ever collected in tropical Africa. He was the author of several botanical papers of a high order of merit.

Mr. W. H. SEAMAN of Washington sends us the following note: "I send you by mail a small tin box containing minerals, which are specimens of an incrustation, forming on parts of the northern face of the Washington monument in this city. It is about two hundred feet high, unfinished, and the top protected by an imperfect shed of boards. The walls are gneiss faced with marble, and this curious stalagmite, for such it really is, appears to be formed by the water percolating from the top of the wall through the joints, and dissolving a part of the mortar which is deposited upon its outer surface. The deposits always commence at a joint and widen as they descend like the letter A, covering sometimes several square feet, usually firmly attached to the marble. The edifice has been built about twenty years. Mr. Clark, architect of the Capitol, states that a similar incrustation forms on the inside of the arches, under the capitol steps, but it is scraped off every year." It is certainly interesting as an example of natural deposit under artificial conditions.

WE are glad to inform our readers that the tax on alcohol, so grievous to museums, is to be removed when used for scientific purposes. According to the Boston "Journal" Prof. Agassiz's bill, as it is called, to remit the excise duties on alcohol used for scientific purposes, which was passed by the House on the 23d, was passed February 12th by the Senate, and will soon become a law. The bill provides that the alcohol can be withdrawn from bond by the Presidents or Curators of scientific institutions or colleges, for the sole and exclusive purpose of preserving specimens of anatomy, physiology or of natural history, or for use in any chemical laboratory of such institutions; and if any alcohol thus obtained shall be used for any other purposes than those specified, then the officers of the institution or their sureties shall pay the tax on the whole amount withdrawn from bond, together with a like amount as a penalty in addition thereto.

WE regret to announce the death of Prof. F. B. Maury, the author of the "Physical Geography of the Sea" and of "Sailing Directions" for seamen.

THE Government has appropriated $75,000 for the continuance next year of Prof. Hayden's geological survey of the public lands, and $10,000 for the completion of the reports of Mr. Powell's expedition.

DR. O. NORDSTED describes in the sixth part of the "Ofversigt" of the Stockholm Academy of Sciences for 1872 the Desmidiaceæ collected by the Swedish expeditions in 1868 and 1870 to Spitzbergen and Bear Island. Fifty species are enumerated, nine being described as new, and carefully figured.— *Journal of Botany.*

ANSWERS TO CORRESPONDENTS.

M. R. S., Canandaigua, N. Y. — The birds referred to by you are, as you supposed, the snow bunting (*Plectophanes nivalis*), and the snow bird (*Junco hyemalis*). Their habitat is given in Coues' "Key to North American Birds," and their habits are quite fully described in the works of Wilson, Audubon and Nuttall. — J. A. A.

BOOKS RECEIVED.

Bidrag till Ofversigt af sveriges ichthyologiska literatur. Akademisk Afhandlung som med vidtberomda filosofiska fakultetens i Upsala tillstand for Filosofiska Gradens erhallende till offentlig granskning framstalles af Fredrick Lundberg. 8vo pamph. pp. 56. Stockholm. 1872.

List de Coleopteres Exotiques en vente chez A. Boucard. No. 8. 12mo pamph. pp. 28. London.

Account of the Exploration of Mammoth Cave. By L. S. Burbank. (From Proc. Bost. Soc. Nat. Hist.) 8vo. pp. 2.

On the Gigantic Fossil Mammals of the order Dinocerata. By O. C. Marsh. (From Am. Jour. Sci. and Arts, Feb., 1873.) 8vo. pp. 8, 2 plates. Received Jan. 29, 1873

Half-hour Recreations in Popular Science. Unconscious Action of the Brain and Epidemic Delusions. By W. B. Carpenter. 12 mo. pp. 64. Boston, 1872.

Third and Fourth Annual Reports of the Geological Survey of Indiana, made during the years 1871 and 1872. By E. T. Cox. 8vo. pp. 488. Indianapolis, 1872.

Maps for Geological Survey of Indiana. 8vo. 1872.

The History of Balanoglossus and Tornaria. By Alexander Agassiz. 4to. pp. 16. Plate 3. Cambridge, 1873.

Entomologische Zeitung. 8vo. pp. 494. With 2 plates. Stettin, 1872.

The Microscope and Microscopical Technology. By Heinrich Frey. Translated from the German by George R. Cutter. 8vo. pp. 658. Illustrated by 343 engravings. New York, 1872.

Jahrbuch der kaiserlich-koniglichen geologischen Reichsanstalt. Band XXII. No. 3. 8vo. pp. 77. 4 plates. *Mineralogische Mittheilungen gesammelt von Gustav Tschermak.* Jahrgang, 1872. Heft 3. pp. 82. 2 plates. Wien, 1872.

Verhandlungen der k. k. geologischen Reichsanstalt. Nos. 11, 12 and 13. 8vo. Wien, 1872.

Recherches Physico-chimiques sur les Articules Aquatiques. Part I. Par Felix Plateau. 4to. pp. 66. Bruxelles, 1870. Part II. 8vo. pp 50. Bruxelles, 1872.

Materiaux pour la faune Belge. Deuxieme Note. Myriapodes. Par Felix Plateau. 8vo. pp. 21. 1 plate. Bruxelles, 1872.

Qu'est-ce que l'aile d'un Insecte. Par Felix Plateau. 8vo. pp. 10. 2 plates.

Tidsskrift for Populære Fremstillinger af Naturvidenskaben. Fjerde Række. Fjerde Binds. Sjette Hefte. 8vo. Kjobenhaven, 1872.

Proceedings of the New England Historic-Genealogical Society, at the Annual Meeting, January 1, 1873. 8vo. pp. 44. Boston.

Arrangement of the Families of Mammals. (From Smithsonian Miscellaneous Collections.) By Theodore Gill. 8vo. pp. 98. Washington, 1872.

Fourteenth Annual Report of the Indiana State Board of Agriculture, 1872, *including the Report of Professor E. T. Cox, State Geologist, for* 1871 *and* 1872. 8vo. pp. 432. Indianapolis.

Twentieth Report of the Superintendent of Public Instruction for the State of Indiana. 8vo. pp. 424. Indianapolis, 1872.

Diagram showing the Progress of the Anthracite Coal Trade of Pennsylvania. By P. W. Sheafer.

Results of Recent Dredging Expeditions on the Coast of New England. (From Am. Jour. Sci. and Arts.) By A. E. Verrill. 8vo. pp. 9. January 18, 1873.

Land and Water. London. Nos. for Dec. 28, 1872; Jan. 4, 18, 25, Feb. 1, 1873.

The Field. London. Nos. for Dec. 28, 1872; Jan. 4, 18, 25, Feb. 1, 1873.

Nature. London. Nos. for Dec., 1872; Jan. 9, 16, 23, 1873.

The Academy. London. Nos. for Dec. 15, 1872; Jan. 1, 15, Feb. 1, 1873.

The American Journal of the Medical Sciences. Philadelphia. Jan., 1873.

The Popular Science Monthly. New York. Jan. and Feb., 1873.

Bulletin Mensuel de la Societe d'Acclimatation. Paris. Tome IX. Nos. for Aug., Sept. and Oct., 1872.

Bulletin de la Societe des Sciences Naturelles de Neuchatel. Neuchatel. Tome IX. Cahier 2. 1872.

Le Naturaliste Canadien. Quebec. Vol. V, No. 1. Jan., 1873.

The Journal of Applied Science. London. Vol. III. Nov. 1, 1872.

Bulletin of the Torrey Botanical Club. New York. Vol. IV, No. 1. 1873.

Revue Scientifique. Paris. Jan. 18, 25, Feb. 1, 1873.

The American Journal of Science and Arts. New Haven. Vol. V. Feb., 1873.

Journal of the Franklin Institute. Philadelphia. Jan. and Feb., 1873.

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A VIVIPAROUS FLY.

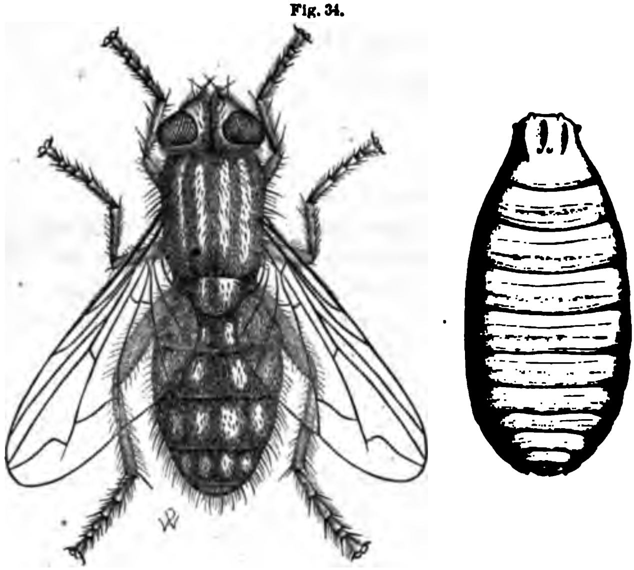
BY REV. SAMUEL LOCKWOOD, PH. D.

THE question, which is the mother of the chicken, the hen that laid the egg, or the hen that hatched it, would have no place in casuistry if all hens produced their chickens ready made. And there is a great deal of difference between the fly that lays simple eggs, and the one that brings forth living grubs. Thus it was, that what we beheld on the 15th day of June had for us all the novelty of a new sensation. The day was very warm, and I was about leaving my study, when my attention was drawn to a peculiar looking fly on the window. As it was quite large, it occurred to me that it would make a nice morsel for the tree toad in the fernery; so the intruder was captured, and I was about presenting the prize to my pet with goggle eyes, but an open countenance, when a sudden change came over my mind; for in the palm of my hand appeared what I took for eggs of an elongate form. My pocket lens at once showed me that these were not eggs, but real, live maggots, each about .06 of an inch in length; and there, right under my own eyes, even in my hand, the parent fly was busily depositing these little squirming things. The fly continued emitting the grubs, almost without cessation, in numbers varying from one to three at a time. They were very active, twisting themselves into animated knots, each containing from three to six individuals. The entire number of grubs emitted was sixty-one; although it may possibly have been more, as I could not find out whether

any had been lost during the act of capture. I put the parent fly and about half her progeny into spirits. They were quite active in the strong 95 per cent. alcohol, and lived a good while, although the fly soon died.

Dr. Packard has kindly determined the species for us, and its systematic name is *Sarcophaga carnaria* Linn. (Fig. 34). Though ignorant of the habits of this curious fly, I resolved to make an effort to raise the remaining larvæ. They were now three hours old, and the little things were becoming less active because of the de-

Fig. 34.



The Viviparous Fly and its Pupa Case.

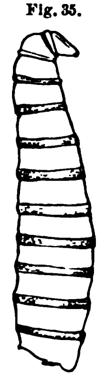
siccating effect of the hot atmosphere. There was no time to lose, so I took a flower-pot, and filled it with porous or sandy earth, and set the pot in a saucer with sufficient water to make it a little moist. Next a bit of fresh kidney fat was put on the earth. On this flesh I laid the tiny grubs, and was soon gratified with seeing the most vigorous of them instinctively recede into the folds of the fat, and thus disappear. A glass tumbler was next put over all, and the arrangement was complete.

Four days' absence from home, and no observations. The larvæ were now a little over five days old and, with the exception of one,

had all entered the ground. This one, which lay between the flesh and the earth, was the straggler of the company. Perhaps it was weak, as it was making ineffectual efforts to follow its companions in their search for proper places for their pupa sleep. But why should it be weak? It certainly was as large — it seemed, I thought, even larger than any of those that had successfully retired. Pray, you, who think that instinct cannot err, are there not larvæ which are gluttons? Or, turning to the man of facts, do larvæ ever overfeed? Whatever the facts may be, the case suggested parallel instances, wherein bipedal gourmands had found it difficult to get away from the relics of the feast, although all else were comfortably off to their dormitories.

I now carefully examined the earth in the flower-pot, and found the larvæ of large size and in holes reaching nearly to the bottom of the pot. They are now six days old, and have left the flesh just half a day. Measuring one of these white maggots of the average size, its length in fractions of an inch was .50 and the breadth was .25. It should be remembered that, generally, larvæ when disturbed contract their dimensions. The same larva when in motion was in length .85. One of these fully grown larvæ (Fig. 35) was put into alcohol of ninety-five proof. It continued quite active for 84 minutes, and sustained life in this element 134 minutes, all of which time it was completely immersed in the fluid.

Fig. 35.



Larva of Flesh Fly.

June 22d.—The larvæ have taken on their brown pupa cases, and pretty things they are, of a cylindrical form, with an erect little fringe at the posterior end, something like the crown on a whortleberry (Fig. 35). There are still three of these white grubs that have not yet taken on their pupa change. These, though rather lively when disturbed, like other indolent people, must be regarded as laggards, for all that, and so were taken out and devoted to experiment. One was immersed in clear turpentine, another in Fowler's solution of arsenic, and the third in essence of peppermint of full strength. Repeating the previous experiment the results stand thus:

A fully grown larva six days old in 95 per cent. alcohol was quite active for 84 minutes, and lived 134 minutes; of the fully grown larvæ seven days old, the one in turpentine spun rapidly in the fluid, and motion ceased in 27 minutes; the one in essence of

peppermint kept up motion for 70 minutes; the one in Fowler's solution only ceased motion at the end of 53 minutes.

In the light of such facts, what reprobation is too severe upon the useless and cruel practice of drenching horses with violent medicaments for the bots? The ailment thus known is due to the presence in the animal's stomach of the larvæ of the bot-fly (*Gastrophilus equi* Fabr.). By its formidable mouth-hooks this larva clings to the walls of the stomach. Now it must be evident that by such methods of treatment, either to kill this parasite, or detach it from its hold would require medicines in such quantity, and of such power, that death to the poor animal would become inevitable before even its tormentors had been materially affected. Scarcity of specimens limited the experiments. I had meant to try the effect of suffocation, by immersing them in some one of the animal oils, for it is possible that herein may be found a simple remedy for that malady in horses.*

July 6th.—The glass on the flower-pot has been carelessly displaced several days. I noticed certain depressions in the earth, such as are made when little holes are filled up by the crumbling of their sides. The sight was ominous. Imagine the feelings which prompted me to exclaim suspiciously, "The imagines are gone." Alas, it was so! From the dryness of the depressions, and other indications, I was satisfied that the perfect flies had taken flight on the Fourth of July—thus, in a way against which no despot could demur, they had entered on their freedom on Independence Day! All this was very fine; but believing that patriotism should not extend to flies, the whole transaction did violence to my scientific instincts. In chagrin I slowly removed the earth

* Long ago my attention was called to the tenacity of larval life when exposed to poisons. I was forced by the claims of justice to take part in a toxicological examination of the internal organs of a person who had been nine months buried. These were put in a large glass jar, and the jar filled with water. It was summer. A small portion of the viscera rose above the fluid. In three or four days, I noticed the presence of a great number of large white larvæ, doubtless of the common blow-fly. We obtained enough bichloride of mercury, to establish the fact that the woman had died by taking a very large quantity of this terrible poison. Naturalists know how well this drug will preserve animal tissues. And in this case, the blood in the capillary vessels was of a bright color, as if fresh. And despite the presence of so much poison, the larvæ grew. Whether they would change to flies, I cannot say. Another case is that of the horse of a friend, which was injured by accident and had to be killed. The animal was opened, and the walls of the stomach were found to be covered with the larvæ of the bot-fly. A piece of the stomach was spread on a board in the sun. Some turpentine was poured on the larvæ, with but little effect, as not one was detached, when it was examined an hour afterwards. Some whale oil was then poured on them. They let go immediately, and soon all died.

from the pot. There were the little coffins—eight of them, and all empty. One was so much smaller than the others, that I concluded it must have contained a male. Very pretty things were these little cylindrical cases — the pupa coverings. (Fig. 34). At the thicker end a tiny lid was uplifted, much as if the sawn-off end of a cocoanut should serve as a lid to the shell, and should be raised to let out a captive bird.

So each having made for itself a little coffin had lain therein just thirteen days. "*Thirteen* days," whispered a friend, a little superstitious about that number. "*Thirteen* days! The fault of their escape is not yours at all. It is a clear case of bad luck." Well, my good friend, your theory is charitable at the least. But in my humble and penitent judgment, it does not condone the blunder which at the auspicious moment allowed the prize to fly away. Nature, like the Oracle, exacts of her inquirers watchful attention.

THE PRAIRIE BIRDS OF SOUTHERN ILLINOIS.

BY ROBERT RIDGWAY.

HAVING familiarized the readers of the NATURALIST to some extent with the general character and appearance of the prairies of Southern Illinois in our article on "The Woods and Prairies of the Upland Portions," I shall now give an account of an ornithological reconnoissance of Fox Prairie, in Richland county, made in the summer of 1871 As this reconnoissance resulted in the discovery of several species of birds new to the state,* a few details concerning it may not be uninteresting to our readers. The field of our observations was a prairie of considerable extent, lying about four miles to the westward of the town of Olney, on the Ohio and Mississippi Railroad, and is merely one of the numerous arms or bays of the Grand Prairie which extend eastward into the forest region of the Wabash valley.

My companions and I arrived at it a little before noon, and saw before us the usual modern prairie prospect. A rolling plain spread away from us, the farther side bounded by the border of timber, while the prairie itself was treeless, except where some

* See AMERICAN NATURALIST, Vol. VI, July, p. 430.

stream was followed by a narrow line of thickets with a few large trees interspersed. Around us were the tangled thickets which we have before described, while the small, but growing trees which sprang up among them gave plain evidence of the gradual encroachment of the woods upon the original prairie. The herds of horses and cattle which dotted the gently undulating surface of the prairie, and an occasional neat frame farmhouse, with its attendant fields and orchard, made us realize that we were yet within the bounds of comfortable and advanced civilization. Just before us the prairie was intersected by a ravine, through which ran a small stream whose narrow valley was filled with a thicket of varied shrubbery, and the brook itself bordered by a few large-sized trees, which were chiefly the white elm, several kinds of oaks, and an occasional cottonwood.

The day was a delightful one; the sky without a cloud, and, though the heat ranged above 80°, the fresh prairie breeze tempered it to a delightful mildness. As we rested in the shade of a large elm tree in the hollow, and reclined on the cool soft sward, our ears were delighted by such a chorus of bird-songs as we have heard nowhere else. Among the leafy branches overhead the orioles (*Icterus Baltimore*) whistled their mellow flute-like notes, and the little greenlets (*Vireosylvia gilva* and *V. olivacea*) cheered us with a softer warble or richer chant. The birds of the meadow were chanting their several ditties all around us on the open prairie, while the frequent soft refreshing prairie breeze wafted to us from the groves the songs of the woodland species.

In the tangled thickets and scrubby jungle near the border of the woods the finest songsters were found. There the mocking birds (*Mimus polyglottus*) fairly filled the air with their rich medley of inexhaustibly varied notes, the singers leaping in restless ecstasy from branch to branch, with drooping wings and spread tail, or flitting from thicket to thicket as they sang. The brown thrasher (*Harporhynchus rufus*) poured forth a sweet and ceaseless accompaniment, as he sat perched sedately upon the summit of a vine-canopied tree — a contrast in bearing to the restless, sportive Mimus, his rival in song. The yellow-breasted chat (*Icteria virens*), a very abundant and characteristic species, appeared to be straining himself to produce the oddest and most unusual notes he could invent, the singer often going through grotesque and extravagant antics — flitting upward, and then descending by jerks,

his wings and tail raised and legs dangling — the whole time singing with all his might. Mingled with these, the loudest songs, were heard the sweet sad chant of the little field sparrow (*Spizella pusilla*), the pleasant cheerful notes of the ground robin, or "chewink" (*Pipilo erythrophthalmus*), the rich whistlings of the cardinal grosbeak (*Cardinalis Virginianus*), and the glad "bob-white" of the quail (*Ortyx Virginianus*). During a lull in the chorus we heard, from the depths of the thicket, a very curious gabbling, or sputtering song, which was entirely new to us. We hastened to the thicket, and, entering it as far as possible, lay in wait for the strange songster to resume his vocal performance. In a few minutes a little grayish bird carefully approached, flitting cautiously from twig to twig, now and then halting, and, after uttering the peculiar notes which had attracted our attention, would stretch out his neck and eye us with great curiosity and evident suspicion. After observing him carefully to our satisfaction at a distance of hardly a rod, we found that he was Bell's greenlet (*Vireo Bellii*), a species of the plains east of the Rocky Mountains from Texas northward, and not before detected east of the Mississippi river. After we had become satisfied of his identity we shot him; but upon attempting to secure our prize we found the briery undergrowth too intricate and powerful to allow a passage through it. In nearly all the thickets others of the same species were frequently heard, so that it appeared to be common in that locality. The little white-eyed greenlet (*V. Noveboracensis*) was also common in the same thickets, and was easily distinguished by his well-known notes, an attempted translation of which gives it the local name of "chickty-beaver bird." As we remained patiently watching for the specimen of Bell's vireo, spoken of above, other little birds would now and then hop cautiously near us, or flit through the undergrowth before us. Among these were recognized the chestnut-sided warbler (*Dendrœca Pensylvanica*), the golden winged warbler (*Helminthophaga chrysoptera*), and a pair of mourning warblers (*Geothlypis Philadelphia*). The first two species represent in the scantily wooded portions the cærulean warbler (*D. cærulea*) and the blue-winged yellow warbler (*H. pinus*) of the forests of the bottom-lands.

In the open groves at the border of the timber, the usual woodland species were noticed; and among them, the vermilion tanagers (*Pyranga æstiva*) frequently warbled their robin-like, but

vigorous and well-sustained song, the blue jays (*Cyanura cristata*) squalled and chattered as they prowled among the branches; while the red-headed woodpeckers (*Melanerpes erythrocephalus*) frolicked among the trees. The most abundant bird besides the foregoing species was the tufted titmouse (*Lophophanes bicolor*), which nearly mimicked the jays in both habits and notes.

On the open prairie the birds were all entirely different. The meadow lark (*Sturnella magna* — the true *magna*, and not at all approaching *S. neglecta*, in either manners, notes or plumage!) was the most conspicuous, from its size and the plaintive sweetness of its song. The "dick sissel" (*Euspiza Americana*) was perhaps the most abundant bird, and the males were perched upon the tall coarse weeds all around us, chanting their vigorous but rude ditties. Henslow's bunting (*Coturniculus Henslowi*) and the yellow-winged bunting (*C. passerinus*) were scarcely less abundant, and like the dick sissels were perched upon the tops of the weed-stalks, uttering their simple, abrupt lisping songs. Though we had never met with Henslow's bunting before, we found it to be much more common here than the *C. passerinus*, and in a little while easily succeeded in securing seven fine specimens. At the edge of a pond we saw what we thought to be the *Passerculus savanna*, but the bird escaped by running into the grass after we had crippled it. Over the surface of the pond were flitting and hovering a couple of black terns (*Hydrochelidon fissipes*), while among the rushes and sedges of its border the red-winged blackbirds (*Agelæus phœniceus*), and both species of marsh wrens (*Telmatodytes palustris* and *Cistothorus stellaris*), were nesting; and when away from the pond, we were certain that we heard the harsh grating notes of the yellow-headed blackbird (*Xanthocephalus icterocephalus*), well known to us, but we did not see this species there. In the grassy portions of the prairie the field plover (*Actiturus Bartramius*) was more or less common, and, except the killdeer (*Ægialitis vociferus*), was the only other species of the family observed there. The lark bunting (*Chondestes grammaca*) was more or less common about the border of the corn-fields and scattered groves along the edge of the prairie, and we listened to its vivacious and unusually vigorous song with more pleasure than we had felt upon hearing any other bird during the day, for we regard this bird as the finest singer of its family on the continent; its sprightly, remarkably continued song, having a peculiar emo-

tional trill in various parts, and such beautiful rising and falling cadences, in addition to its other pleasing qualities, that we consider it unequalled in these respects among all the numerous fringilline songsters of the United States. A frequent companion of this species was the indigo bird (*Cyanospiza cyanea*), and more rare one, the grass, or bay-winged bunting (*Pooecetes gramineus*). Besides the species named, but few birds were noticed that day, and these were the more generally distributed species, which are hardly worthy of mention, as the catbird (*Galeoscoptes Carolinensis*), red-bellied woodpecker (*Centurus Carolinus*), flicker (*Colaptes auratus*), and such species as are seen every day in nearly all localities. Once a pair of croaking ravens (*Corvus carnivorus*) made their appearance, and after circling about over the border of the woods for a few minutes, left for the heavy timber of Fox Creek bottoms. The red-tailed and red-shouldered hen hawks (*Buteo borealis* and *B. lineatus*) were occasionally seen, while now and then one or two swallow-tailed kites (*Nauclerus forficatus*) would be noticed floating about in broad circles in the clear blue sky, usually accompanied by the Mississippi kite (*Ictinia Mississippiensis*). The little sparrow falcon (*Tinnunculus sparverius*), the sharp-shinned and Cooper's hawks (*Accipiter fuscus* and *A. Cooperii*), completed the list of birds of prey which we observed that day.

Early in August of the same summer we visited this locality a second time, and found its entire aspect changed. The season of severe drought having passed, we found a profusion of flowers giving a gay and varied color to the prairie, which before was comparatively brown and sober in the appearance of its vegetation. The birds which were most conspicuous were nearly all different from those noticed at our former visit. The mocking birds, brown thrashers and chats, were silent, while a few of the other singers occasionally cheered us with their song. The shrill screech of a very large species of Cicada repeatedly startled us as we brushed against a weed, while numerous varieties of grasshoppers were far more noisy than the birds, and seemed almost the only active beings during the sultry noontime of that cloudless day; for the thermometer stood in the nineties, although the heat was considerably tempered by a steady refreshing breeze. To compensate for this silence of the birds, however, as we came upon the open prairie, a beautiful and unlooked for sight attracted our

attention. Numbers of exquisitely graceful swallow-tailed kites or "snake hawks" (*Nauclerus forficatus*, also locally known as "fish-tail hawk") were seen sailing about in every direction; we were completely transfixed by the beautiful spectacle they presented as they floated about in graceful circles, while they were so unmindful of us as to pass repeatedly within a few yards of us. Soaring gracefully above them with a similar flight were smaller numbers of the "blue kite" (*Ictinia Mississippiensis*), which, more suspicious, seldom approached so near. The latter birds, though far less striking in appearance than the swallow-tails, were nevertheless superior to them in power of flight, for they had a very interesting habit of suddenly pitching downward from a great height almost to the ground, and again ascending by a steep angle nearly to the level from which they started; the whole performance accompanied without a single flap of the wings, which in the descent were merely extended at the elbows and inclined inwards at the tip, and the rapid fall checked by suddenly extending the wings, which were thus held motionless as the bird mounted again. Frequently two or three would pass each other at different angles as they performed these beautiful evolutions, and presented a sight pleasing and interesting in the extreme. The power of flight of these kites may be better appreciated by the fact that they frequently appeared and passed rapidly and easily by the turkey buzzards (*Cathartes aura*) which happened to be sailing majestically in the same direction. The swallow-tails were never noticed performing these evolutions; though for ease and grace their buoyant, floating flight certainly cannot be excelled.

The swallow-tails were so numerous and tame that once, when half a dozen or so were sailing about, we killed one with each barrel of our gun, in quick succession. A couple of full-grown young of this species were seen upon a dead tree along the stream, and while we were watching them the parent bird approached, evidently with food for them, for they commenced dancing up and down upon the branch, and whistled impatiently, when she hovered over them. The Mississippi kites would never approach us near enough for a shot, so that we found them far more difficult to shoot than the swallow-tails. The three specimens obtained we secured by stratagem; our most successful plan being to approach them in our wagon. These kites were frequently observed resting upon the tops of the dead trees along the stream, and by approach-

ing with the team until we were concealed for a moment by the intervening underwood, I would jump out and leave my companions to keep on with the wagon. While the unsuspecting kite was intently watching the passing team, I found it usually quite easy to steal through the thickets near enough to the tree to shoot it. In this manner I succeeded in shooting three fine specimens during the day.

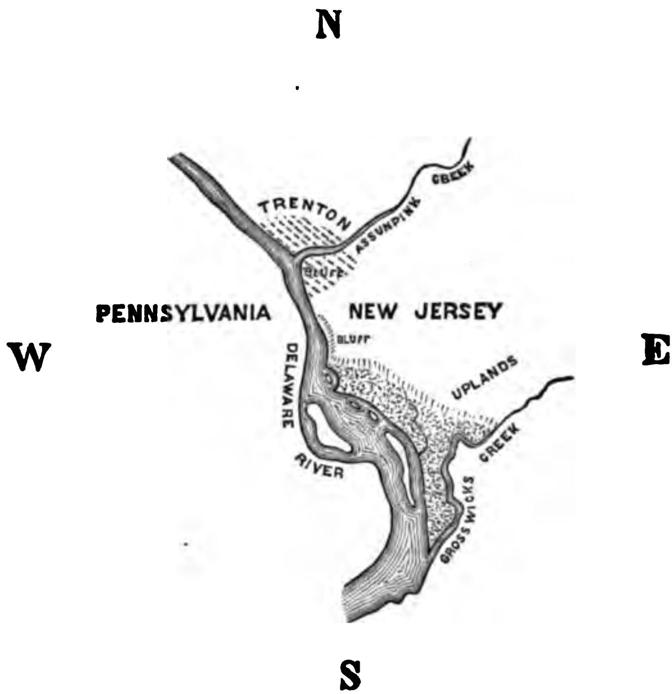
While driving across the prairie, in the course of my hunt after these birds, I observed what appeared to be a Mississippi kite perched upon a dead tree in a bushy ravine. We approached it as described above, and as we drew nearer, we noticed something in its appearance which caused us to see that it was not an *Ictinia*. We were almost near enough to shoot from the wagon, when it flew, and began circling about, when it was immediately assaulted by two or three Ictinias, that continued to annoy it. When immediately overhead I shot at it, but without serious effect, for it immediately flew straight into a large elm tree in the ravine, and alighted among the branches. As it soared about above us I immediately recognized it as the *Asturina plagiata*, a species which is so strongly marked in all its characters, the plumage especially, that no other hawk could possibly be mistaken for it by one at all acquainted with this family. I succeeded in getting another shot at it, but the distance was so great that the bird escaped.

In this article I have named the more abundant and characteristic birds of the prairie portions of southern Illinois. Future observations, in such favorable localities as that explored by us, will no doubt reveal many additional, and perhaps several unlooked-for species, when we take into consideration the fact that my acquaintance with the prairie avi-fauna depends solely on these two trips. The number of species actually observed in the locality, numbered about ninety-five on each occasion; while the species breeding in the immediate neighborhood are about one hundred and forty, a very rich avi-fauna for a restricted locality, when the fact is taken into consideration, that of this number only about twenty-five are water birds — the remainder of one hundred and fifteen species of land birds being, perhaps, as large a number of regular summer residents as any single locality in North America can boast.

OCCURRENCE OF IMPLEMENTS IN THE RIVER DRIFT AT TRENTON, NEW JERSEY.

BY CHARLES C. ABBOTT, M.D.

THE discovery of unquestionable river-drift implements in this country has been an occurrence of great rarity, in comparison with the extensive unearthing of such implements in Europe and



more especially in France. There does not seem to be any known stratum of river-drift that contains such specimens of archaic implements as have been found by archæologists, *in situ*, at Amiens and St. Acheul,* France, and therefore the occurrence of a single

* We have already called attention to the similarity of certain rudely chipped implements found near Trenton, N. J. (Amer. Nat. vol. VI. p. 146, fig. 9), to those found at St. Acheul, and Prof. Wyman (Fifth Ann. Rep. of Peabody Museum of Amer. Archæol. and Ethnol. p. 27) also mentions this similarity, saying of two or three specimens sent him, "except for their material, *they* could hardly be distinguished from them." These

specimen of strangely shaped stone, that appears to be an "implement" may be looked upon perhaps, very doubtfully, as establishing the facts that it is a stone that has been so shaped by human hands; or if so that it is of the same date as the containing bed of river drift. Such doubts, we confess, passed through our mind as we dug out from a gravelly bluff or hillside, then being removed, the specimen to which we would first call attention, but before describing it we will mention the characteristic features of the gravel bank itself, as it was when this specimen was found.

The physical geography of the locality is very nearly as follows: The south bank of the Assunpink Creek, where the stream empties into the river, was originally a high gravelly bank, having its greatest elevation at the mouth of the stream, and gradually disappearing as it extended up the stream, or in an easterly direction, almost, at this point, at right angles with the river. The northern shore sloped gradually to the creek; the high ground being a full half mile from the stream.

As we pass down the river shore, on the New Jersey side, we find the same gravelly bluff reappearing at the river side, after a stretch of lower and meadow-like land, now all built upon; and this river side bluff, after extending a distance down the stream of half a mile, suddenly leaves the river, trends eastward, and leaves between it and the river, the extent of meadows that is indicated by the dotted portion of the map.

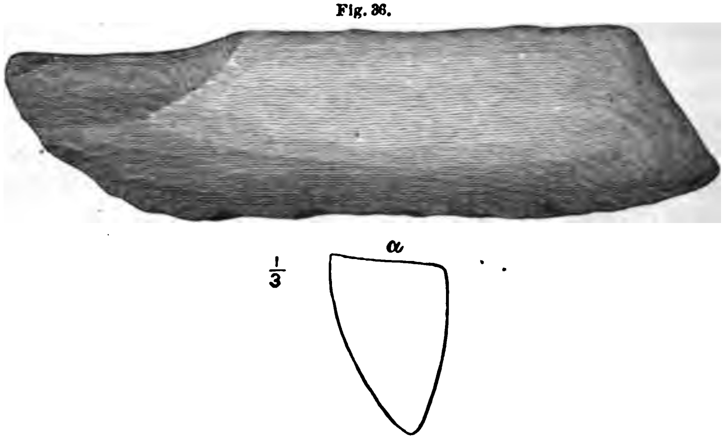
On this meadow, and in the uplands above (see map), and also in the graves in the hillside dividing the two sections of meadow and upland, are found the thousands of "relics" such as we have described somewhat in detail in vol. VI, of this journal. The specimens that are more particularly described in this paper were found in the bluffs, at those points where the word "bluff" is printed on the map. At these two points, the river on the one hand, and "city improvements" on the other, have exposed the hillsides and made such sections of them as enable the observer

specimens, however, are not true drift implements, inasmuch as they are also found upon the surface, associated with ordinary "Indian relics," and when found in gravel, it is nearer the surface of the ground and in such position as renders it possible that they may have gradually worked down to the depth at which they occur. Of the age, as a class, however, of these rude implements, we maintain that they are much older than the finely worked "relics" which are, except when in graves, strictly surface-found implements; that is, stone implements discarded and lost previous to, and at the date of, the arrival of European settlers; who introducing metals, especially iron, made the stone weapons of the Red man comparatively of little value.

to see their geological construction at a glance. This construction is in each case alternate layers of fine sand and gravel, the latter being far in excess of the former; and we have designated the specimens here figured as "drift implements," and consider them as wholly different from the rude implements already referred to, inasmuch as all three were taken from this gravel at great depth, and all *beneath undisturbed layers of fine sand.*

Figure 36 represents the first of the three "drift" implements found deeply in drift gravel. It was brought to light in September, 1872, in removing the steep hillside that formed the east side of Cooper street, near Factory street, in the city of Trenton. The specimen itself, when discovered by us, was lying *in situ*, sur-

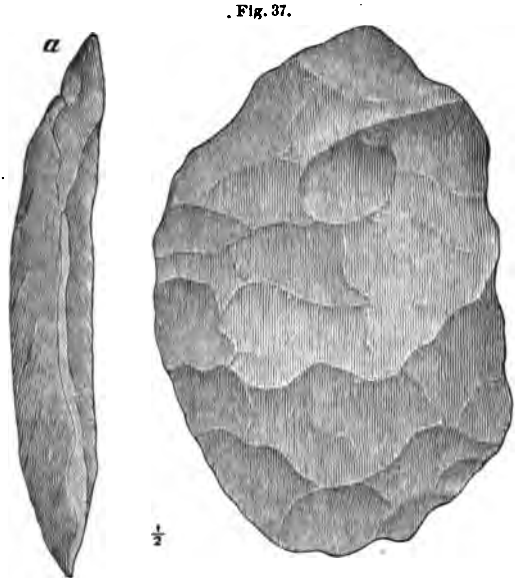
Fig. 36.



rounded by gravel, and there were two layers of undisturbed sand of one foot and twenty inches respectively in thickness above it; between these sand strata was a heavy stratum of fine gravel; above them another; and the loam above that. The stratum of gravel in which the specimen was found was three feet in thickness above the specimen, which was about two feet above the level of the street. The depth from the surface of the ground to the specimen, which was ascertained before the removal of the implement from its bed, was sixteen feet. The specimen was lying in a horizontal position, in fine gravel, and attention was drawn to it by the cutting edge projecting from the face of the hillside or bluff. We were assured by the men who were carting this gravel, that the week previous they had met with two slabs of stone, a foot or

more square, with "queer figures cut deeply into them." We failed to trace these up, and give the rumor only as we heard it. For ourselves, we do not doubt the occurrence of such stones, but the "queer figures" may not have been of human origin. The implement which we represent in Fig. 36 is a mass of reddish brown stone, compact, laminated and susceptible of a high polish. It appears to have been a hatchet with the handle "all in one." The end of the blade has been extended beyond the back of the implement, one inch and a half, giving the specimen a very knife-like appearance. The handle is three and one-quarter inches in length,

Fig. 37.



and has been formed by cutting through *one* of the layers of the stone, thus making it much thinner than the rest of the implement along the "back" of the cutting portion. The specimen measures, handle and blade included, along the back, nine and one-half inches; along the front or edge, eleven and one-quarter inches. The cutting-edge has undoubtedly been chipped, and although the specimen is now much water-worn, the flaking can still be seen extending along the whole edge. Had this specimen been found upon the surface of the ground no one would question its being a "relic;" and found where and as it was, we believe it to be a

" drift implement," because of this very chipping of its cutting edge. It is inconceivable to us that any amount of water action, or rough and tumble existence with moving gravel, or even any action of a glacial nature, could produce this chipping along the edge, and conveniently add a handle to an accidentally produced cutting implement.

Fig. 38.

Figure 37 represents an implement of opaque yellowish quartz that bears more resemblance to the European forms of drift implements than does the preceding. In Reliquiæ Aquitanicæ,* there is figured a " large broad flake, worked into a lanceolate form by careful chipping along the edges of the outer face," which specimen is quite similar to the one we have figured. The specimen, figure 37, has evidently been broken off from a boulder, and subsequently chipped along its edges. It is irregularly lanceolate in form, five and one-quarter inches in length, and three and one-half inches in greatest width. Although both faces are now equally water and weather-worn, it is shown by the specimen's concavo-convex shape, that the latter is the outer or natural surface of the stone. It is slightly darker in color, and more irregular, as though the stone had been somewhat chipped before the flake itself was detached.

This chipped flake was found in the same gravelly bluff, as the preceding, but at some distance from it, being the point previously referred to as immediately facing the river, as shown in the map by the word " bluff." It, too, was found by the writer *in situ*

* Rel. Acq. A. pl. III, fig. 1.

and beneath an undisturbed stratum of fine sand about twenty inches in thickness. It is above this stratum of sand, in the gravel that has only the loam above it, that very many of the rude implements have occurred, to which attention was called in the NATURALIST, in March of the past year.

Figure 38 represents the third specimen of drift implements which we have so far discovered in the Trenton gravels. It is a flake of sandstone rock, six and one-half inches in length by three and one-half inches in width. This specimen differs materially from the preceding, in being perfectly flat upon the under surface, and flaked to the edges, from a point upon the other side, by detaching large scales, all starting from this one point or "bulb of percussion." This specimen, therefore, bears much resemblance to the rude implements we frequently find on the surface, and which are popularly called "turtle backs." They are either finished implements or "cones," from which flakes for arrowheads were detached. We incline to the former opinion.

This drift implement (Fig. 38) was found within fifty yards of the first specimen we described, but above it geologically, having but a single layer of undisturbed sand above it. The specimen itself was found by the writer, *in situ*, immediately beneath this layer of sand, at a depth of about eight and one-half feet from the brow of the hill.

To briefly sum up the reasons for separating the above described specimens from the relics of the surface, and the rude implements of the upper gravel and surface, we have but to say that having found them in position, beneath undisturbed strata of sand, we cannot but maintain their greater age; and as we have found three specimens, we consider that each proves the human origin of the other, and that collectively they show that they are true drift implements, fashioned and used by a people far antedating the people who subsequently occupied this same territory, and have left such abundant traces of their presence.

Had but a single specimen been found, we might reasonably, perhaps, applied to it the doctrine of chances, and maintained that it was merely a freak of nature, but the occurrence of three specimens so near each other effectually disposes of the justice of such an opinion, and we must admit the antiquity of American man to be greater than the advent of the so-called "Indian."

COMPARISON OF THE GLACIAL PHENOMENA OF NEW ENGLAND WITH THOSE OF EUROPE.

BY A. S. PACKARD, JR.

DURING a hurried tour through the Alps and Norway, I endeavored to observe marks of ancient glaciers in those countries in order to compare them with the phenomena to be observed in our northern states. The impression made on my mind, and I doubt not on that of other Americans who have travelled in the Alps and Scandinavia, was that the evidences of the former presence of glaciers, in valleys at the heads of which are glaciers now existing, were scarcely more distinct than in the valleys of the White Mountains, of the Adirondacks and even the coast of New England.

As one approaches the Alps from the valley leading from Munich up to Kempten, it could be readily seen that near the lower mountains the valleys were flanked by rounded moraines, clothed with pines and firs, and no better marked than those in the valley of the Saco about Conway. Their presence was revealed by the clearings made in the forests in the same manner as in the White Mountains and the Adirondacks. In one important feature the marks were less apparent, as one does not see in the Alps the broad trains of boulders so common in New England, since they have been artificially removed * during centuries of occupation of the country.

It was more difficult to detect striated and rounded rocks in the Alpine valleys than I had imagined from the accounts of Alpine geologists and travellers.

It was wonderful how nature has sought as it were to conceal the work of the ice period, through atmospheric agencies, in remodelling the materials of moraines, in reducing their former proportions and covering them up by the rapid growth of forests. The same process has gone on in northeastern America, and it is not improbable that about the same amount of time has been consumed in the work; namely, the ice period was contemporary in

* Professor Guyot informs me that the Swiss farmers often bury the boulders below the reach of the plough. The larger ones are sometimes blasted and split into building stones, while others, as with us, have been used for building fences. In some cantons laws have been enacted protecting the more remarkable boulders. (See NATURALIST, Vol. vi, p. 713.)

both continents. During a stay of nearly three weeks in Switzerland, several days of which I spent on foot in crossing the principal passes, I was unable to find among the specimens, I had endeavored to obtain for the museum of the Peabody Academy, a boulder scratched and polished sufficiently to be a fair sample of such work. Those that I did obtain *i.e.* small boulders, samples of glacial mud and gravel, could easily be mistaken for similar specimens from a glacial moraine at the mouth of the Peabody river at Gorham, New Hampshire. In all respects, this last named moraine is, in its glacial characters, the exact equivalent of the moraines at the edges of Alpine glaciers.

It is not until one crosses over by the great Scheideck Pass into the valley of Hasli that he sees the most magnificent examples of polished and grooved rocks, and on a scale perhaps exceeding anything in America. It was not to be wondered at, however, that geologists had been slow to realize that so large a portion of Switzerland had been glaciated.

In Sweden, but especially in Norway, where there are large glaciers and very extensive *mers de glace* on the summits of some of the mountain ranges, the ice marks are everywhere present, but scarcely more apparent than in the White Mountain valleys. At one place on a low rocky point projecting into the Sogne Fjord, there was a magnificent display of deeply grooved and furrowed rocks. But even with the marks at this locality, the enormous grooves on a hill within the city limits of Salem would compare favorably. In Norway, I was not able, so hasty was my journey over the country, to secure any samples from moraines recent enough to compare with moraines in the White Mountains. In Wales the glacial phenomena are on a diminutive scale compared even with the White Mountains, but in walking through the celebrated Pass of Llanberis the polished rocks, boulders and moraines, from one of which I was able to secure samples of glacial gravel, were of the same character as is to be seen in the White Mountains, and scarcely better marked.

Another point of much interest was the comparison of the glacial marine beds of Sweden and Norway with those of New England. While, as is well known, the life of the glacial epoch is almost identical in the two countries, the fossils found at Uddevalla in Sweden, as long since pointed out by Lyell, so exactly repeating the characteristic forms found by Bayfield in the clays of the river

St. Lawrence, and the few species peculiar to each deposit are migrations from the south—it was interesting to see that the lithological characters of the formation were the same in both. Approaching the Baltic coast of Sweden, and nearing the city of Stockholm, the train carries the traveller over extensive beds of clay with exactly the scenic features and color of those of the coast of Maine, presenting long slopes bounded by hillocks of pale gray clay with furrowed sides, worn into the same peculiar shapes by the rains. At the fine museum of the national Geological Survey, under the direction of Professor Torell, I was enabled to see a typical collection of the fossils of these clays. It was interesting to see the *Leda truncata* (L. Portlandica) so abundant in Maine beds, and the *Yoldia pygmæa* not infrequent in the Maine glacial beds. The abundance of this arctic Leda in deposits on both sides of the Atlantic shows how much more uniform was the marine life at that time. Changes in the level of the land, and consequently in its temperature, in the ocean currents, slight though they were, have brought about the changes in the distribution of life in the New England seas. Many arctic species and arctic varieties of species, though still living on our coast, are now to be sought in the abysses of our seas.

The explorations under the auspices of the United States Fish Commission, in the Coast Survey Steamer Bache last autumn (see Prof. Verrill's report in the Amer. Jour. Science, 1872), show how vividly we may restore the ancient marine life of the shores of New England and the St. Lawrence river below Montreal. Here, at a depth of 85–150 fathoms and over, were found living the *Arca pectunculoides*, so abundant in the glacial beds of Norway, though it has not been found in our glacial deposits. The discovery of this and other animals so near our shores, as well as the results of Count Pourtales' researches, and Mr. Whiteaves' dredgings in the Gulf of St. Lawrence, shows that the belt of arctic life as developed on the coast of Finmark at the present day extends southwards in all the deeper parts of the Atlantic ocean north of the West Indies, with its outliers in the Gulf of St. Lawrence. During the glacial period, when the sea stood two or three hundred feet deep over the present coast line of Maine, and still higher over that of the shores of the St. Lawrence Gulf, and Labrador, this belt of life was continuous up to the shallows and estuaries of the land during the period of the deposition of our clay beds. This fact should

stimulate us anew to prosecute with still greater ardor deep-sea dredgings off our coast, particularly the northeast extremity of the St. Georges Banks, with the hope of finding that now strangely interesting shell, *Leda truncata*, which has been brought home from the seas of Greenland in a recent state by arctic voyagers; and on the other hand, to investigate the clay beds of the coast of New England, and Canada and Labrador with the hope of finding the *Arca pectunculoides*, which we can now with some degree of safety predict will be eventually found. The kind of bottom the writer found on the northeastern end of St. Georges Banks, and which proved so remarkably rich in molluscan and vermian life, was a sandy mud, much like that of the richest fossiliferous beds in our glacial formation.

We have but glanced at the identical features of the glacial phenomena of the Alps, Scandinavia and northeastern America, a matter which our geologists have doubtless each observed for themselves, and which struck Prof. Agassiz when he first arrived in this country after his years of exploration in the Alps, and journeys in Scotland and Wales, but which will perhaps suffer repetition in a popular journal of this character. As Humboldt early in this century expressed his delight at finding identical rocks in the New and Old World, the student of the superficial deposits that cover these rocks cannot restrain his delight at finding them almost identical in both hemispheres. Indeed it may be a comfort to the American student of glacial phenomena to know if he is debarred from visiting the glaciers of the Alps or Norway, or even those of the Rocky Mountains, that in the northern states, their marks are as freshly preserved as in the Old World, except at the very edge of the glaciers themselves when photographs will supply the place of actual vision.

THE COTTON CATERPILLAR.

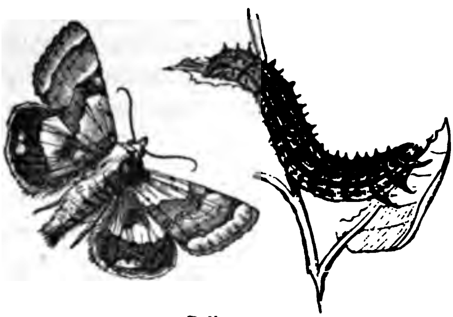
BY LEWIS A. DODGE.

There are two kinds of insects which feed upon and destroy the cotton crop. The boll worm (Fig. 39, caterpillar and moth) eats only the bolls or pods containing the unripe cotton lint. It confines

its ravages to the bolls alone and does not trouble the foliage on the cotton plant. The first brood of boll worms always appears in the corn fields, where it feeds on the silk and leaves of the more tender corn until it is large enough to attack the tough cotton pods, eating into them just as the apple worm eats into the apple.

But the insect which we dread, and which we call the caterpillar* (Fig. 40, moth and caterpillar), eats only the leaves on the cotton plant. The boll worm sometimes attacks the long-staple cotton, but only as an attendant on the caterpillar, completing what the latter had begun. We have twice had our cotton fields eaten out completely since the war and consequently have been compelled to learn something about the habits of the caterpillar. In appearance and size it is at first like the canker worm, but towards the latter part of October it becomes much larger and more active.

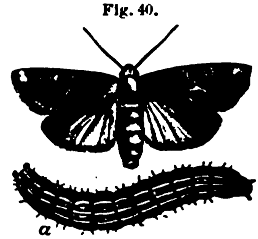
Fig. 39.



Boll worm.

In one respect it differs from the canker-worm—when you touch one, it jumps away three or four inches; but ordinarily it crawls about from leaf to leaf. When first discovered—about the last of July—it is very small, not much larger than the head of a pin and was eating holes through the leaves of the tenderest cotton from the under side. It soon disappeared and in about two weeks we found a new brood which increased in size and numbers much more rapidly than the first. This second brood was confined to spots in the fields, eating all the foliage wherever it began. After eating for about two weeks they began to roll up in the cotton leaves in the form of cocoons and shortly turned into moths, which flew in every direction over the fields and deposited their eggs for

Fig. 40.



Cotton Caterpillar.

* For an account of this caterpillar, the *Anomis xylina*, see the "Guide to the Study of Insects," where Professor Darby relates his experience with it in Alabama.

the third brood. Each female moth is said to lay at least five hundred eggs, so any one can judge how rapid is the increase.

Thus the caterpillars keep on multiplying into new broods till near the middle of November, when the frost kills them off. The common belief among the negroes is that the caterpillar knows when the frost is coming, and takes to the woods, where it sleeps till the next spring, but I have never verified their belief. As the cotton plant gets older and the leaves tougher, the caterpillar increases in size and activity and eats from morning till night. Of course, as the plant loses its leaves, it dries up and the fruit bolls wither and rot, just as apples do under similar conditions. After the worms have taken possession of the fields, it is always estimated that from one-half to three-fourths of the yield has been cut off. We have this year about three hundred acres planted in cotton. At the lowest calculation of price and yield per acre, this ought to turn us in a $16,000 crop; but if the caterpillars get into it, we shall be lucky to get $8,000 out of it.

As to where or how the cotton caterpillar originated, several theories have been advanced. Some say that they came from the Bahama islands to Florida and thence spread up along the coast.* But I suppose they came just as the canker and currant worms came, and it is as easy to account for one as the other. Their development depends much on the state of the atmosphere. Dog-day weather seems to be favorable to their increase and spread, while a hot sun scorches them and renders their food, the leaves, dry and tough. Before the war, they did not appear oftener than once in seven years, and many old and experienced planters say that we have them now oftener, because our method of cultivation is different from theirs and not so thorough. It was always customary to burn off all the cotton fields and old pastures after the frost had killed vegetation, thus destroying any eggs that might have remained unhatched. This practice in many cases is neglected now; and again they say that we put off ploughing up our ground too late; that by ploughing early, the frost has a chance to act on the soil and kill all grubs and eggs deposited under the surface. The darkey also has his reason, which perhaps is as good as any yet assigned. He says the guano brings the caterpillar, reasoning from the fact that it always attacks the rankest cotton

* For an account of the distribution of the army or cotton worm, see the NATURALIST, Vol. iv, p. 52.

first, this having attained its luxuriance through the application of guano. He says the Yankees are so much in a hurry to make money that they use more guano than they ought. Yankees, guano, caterpillars and carpet-baggers are all associated together in his mind. He will not steal guano for this same reason, that he believes it breeds the caterpillars.

We have tried several methods of checking them, but none did much good. We built fires at night around our fields to attract the moths, but they did not seem much inclined to commit suicide. We hired hands to examine the plants and pick off the leaves having eggs on them, but it was a slow and useless job. We heard that insects could not endure the smell of the castor bean plant and so planted rows of them through the fields, but it did no good; on the contrary, they rather liked it. In fact the only effectual remedy was by picking off the worms themselves, thus checking their spread. But one hundred hands picking all day would not gather more than two or three barrels, and at night there seemed to be just as many in the field, though their increase was evidently lessened. Perhaps you say "why not apply carbolic acid to the plants?" We have tried that too, but you might as well attempt to put out a burning house with a pocket syringe, as to sprinkle a field of a hundred acres. How to keep them off, or how to destroy them after they have come, has not yet been discovered.

No one who has not seen them at work, can conceive of the devastation they commit. We have had a field of over one hundred acres eaten out so clean by them in ten days' time, that it had the appearance of having been burnt over by fire. To-day you see only a few here and there; in less than a week the ground, with every cotton plant and other bush, is one squirming mass of worms. They are born to devour and most faithfully do they execute their mission. When they are in full blast, the air in a cotton-field is filled with a sickening odor of the macerated leaves, and I have thought I could hear the noise of their eating and crawling. I have seen ditches a foot deep for miles, filled to the top with drowned worms, and in one instance the wagon rut for eight miles or more was full of a wriggling mass of them. Dogs, geese, turkeys and birds thrive on them, and forsake all other food for them. The negroes' dogs get fat on them alone; the rice birds desert the rice fields in thousands, preferring the worms to the tender rice.—*Adapted from the Boston Congregationalist.*

ON THE GENUS TINOCERAS AND ITS ALLIES.

BY PROFESSOR O. C. MARSH.

IN the March NATURALIST (p. 157) there is an article by Prof. Cope, on "The Gigantic Mammals of the Genus Eobasileus," which contains no new facts on the subject, but some interesting additions to the list of errors which I have pointed out in the same number (p. 151). This paper purports to have been read at the Dubuque Meeting of the American Association of Science, but obviously includes the results of Prof. Cope's later investigations, as well as some corrections suggested by my recent criticism. This is equally true of the appended paper, which was first issued separately, and has just been republished, in an amended form, in the "Proceedings of the Philadelphia Academy" (p. 11).

Since the March NATURALIST was published, I have had an opportunity, through the kindness of Prof. Agassiz, of examining a series of photographs of the skull described as *Eobasileus cornutus*, by Prof. Cope. These views fully confirm my previous belief in regard to this specimen (p. 153), viz.: that it belongs to my genus Tinoceras, and hence to the Dinocerata. The species is apparently *T. grandis* Marsh. These photographs, moreover, when examined in connection with remains of Dinocerata in the Yale Museum, show conclusively that Prof. Cope has, from the first, mistaken many important characters of his own specimens, and hence his erroneous conclusions in regard to the group to which they belong. His papers on this subject, therefore, should be corrected on the following points, as well as on those I have already mentioned :—1st, The name *Eobasileus* Cope, is a synonym of *Tinoceras* Marsh, which antedates it (p. 152), and the name of the family, Tinoceratidæ, likewise has priority over Eobasiliidæ, which Prof. Cope has recently introduced. 2nd, The name *Loxolophodon* Cope should not be applied to this genus, as there is no satisfactory evidence that the single premolar tooth to which it was first given is generically identical, and the probabilities are against it. 3d, The species *Eobasileus cornutus* Cope appears to be the same as *Tinoceras grandis* Marsh, which was first described. The species *E. furcatus* Cope, founded on portions of supposed nasal bones (which Prof.

Cope has since called frontal bones), has at present no authority, the specimens described being evidently the posterior horn-cores of other known species. Judging from the description, the name *E. pressicornis* Cope, has no better foundation. 4th, The genus *Dinoceras* Marsh, is distinct from *Uintatherium* Leidy, although perhaps nearly related. 5th, The mammals of the above genera cannot be placed in the order *Proboscidea*, but constitute a separate order, *Dinocerata*. 6th, The presence of a proboscis does not directly result from the osteological characters of this group, but is inconsistent with them; and hence the evidence is strongly against it. 7th, The skull in the Dinocerata presents no distinctive Proboscidian features, and the subordinate resemblance in the limb-bones, I pointed out before Prof. Cope wrote anything on the subject. 8th, The presence of canine teeth and horns, alone, was not stated by me to be characteristic of a new order, but other important characters were mentioned (p. 150). 9th, The canines of the Dinocerata do not correspond to the tusks of the elephant, and the latter are not enclosed between the premaxillary and the maxillary, but are inserted in the former bone. 10th, The nasal bones of the Dinocerata are much elongated, and do not have their free extremities extremely short, or deeply excavated. 11th, The frontals do not extend in front of the premaxillaries; their extremities do not form bony projections like shovels, and they do not support horns or processes at both extremities. 12th, The anterior horn-cores are on the nasal bones, and not on the frontals, and they are not composed externally of the maxillaries. 13th, The middle pair of horn-cores are not on the frontals, but on the maxillaries, their inner inferior margin alone being formed of the nasals. 14th, The tarsus and foot are not strictly Proboscidian in character, but show strong Perissodactyl features, *e.g.*, in the absence of a hallux, and in the articulation of the astragalus with both the navicular and cuboid bones.

The species of Dinocerata at present known with certainty are the following:—*Tinoceras anceps* Marsh, *Tinoceras grandis* Marsh, *Uintatherium robustum* Leidy, *Dinoceras mirabilis* Marsh, and *Dinoceras lacustris* Marsh. To these should probably be added *Megacerops Coloradensis* Leidy.

REVIEWS AND BOOK NOTICES.

CALIBAN: THE MISSING LINK.* — This curious volume of Dr. Wilson's, can nowise be compared with his former works, especially the "Prehistoric Annals of Scotland." Indeed, doubts continually arose, during our perusal of it, whether it really could be classed among the many works that of late have appeared, scientifically discussing the question of the ape-descent of man. This volume consists of fourteen chapters, all quite brief; and but eight of them really touching upon that "missing link," that he assumes the evolutionist to consider as the bridge that crosses the chasm now existing between man and his nearest pithecoid relative. This link is curiously interwoven, as it were, with Caliban of Shakespeare's Tempest; and we have in the two hundred and seventy-one pages of the book, a double essay on evolution and poetry, certainly very novel and entertaining, if nothing more; "the object aimed at in the following chapters," being, according to their author, "to place the conceptions of modern science in relation to the assumed brute progenitor of man, alongside of those imaginative picturings, and of the whole world of fancy and superstition pertaining to that elder time; while also, the literary excellences, and the textual difficulties of the two dramas of Shakespeare chiefly appealed to in illustration of the scientific element of inquiry, are made the subjects of careful study." Dr. Wilson has, indeed, placed the conceptions of modern science alongside the whole world of fancy, but in doing so has, we think, misinterpreted modern science in making the Caliban of Shakespeare's fancy the embodiment of the former's sum total of results.

At the very outset, the author continually refers to the "missing link," the Caliban of Darwin's fancy, a mere hypothetical being to make good that writer's theory; but the evolutionist does not intimate that one, but many, links are gone; a whole section, if you will, in the great chain of being. We doubt not for one moment, that Dr. Wilson himself would claim that the Bushman and the European were far different genera, had some geological cataclysm destroyed the intermediate races; and would deny their former existence. So it is just as reasonable, and no more, to deny that

*Caliban: The missing Link. By Daniel Wilson, LL.D. London. Macmillan & Co. 1873. 12mo, pp. 271.

more human apes have existed, as in the supposed case; and no Caliban, we admit, could have filled that intermediate state which thousands of years and many generations must have done. Could not time have accomplished this result? And what of the argument that the "commencing" man would be too helpless to survive? Are the more anthropoid apes in greater danger during infancy, than those smaller monkeys that thrive so well in the tropical forests? Dr. Wilson seems to confound the semi-human and the idiot, but between them we can find nothing in common, and wonder that "the half human intellect," is to him so difficult a matter to realize. Natural selection places all other life — or other agencies, if you will, effect it — in positions favorable to growth and increase, and why not an ape, less brutish than the gorilla, and even less human than the Bushman described by Lichtenstein as presenting "the true physiognomy of the small blue ape of Caffraria." (Quoted by Lubbock, in Origin of Civilization. London, 2d edition, p. 8).

While making many references to various savage races, Dr. Wilson argues really that man is man, of the calibre and ability of the great discoverers, rather than a species of many races, or a being of several species. Mere denial goes but a little way on this assumption. He overlooks that really but a mere handful, as it were, of the human species have effected that advancement which simply benefits the whole. China could never produce a steam engine except as a copy; and the Algonquin Red Indians of this continent are as permanently hunting tribes, and nothing more, as the moon to Caliban was the "lesser light" in comparison with the sun. So there is a vast difference in the mental calibre of the monkeys, which evolution could alone have brought about; and the Kumbekephali, that Dr. Wilson so ingeniously brought to light from their hoary graves in Scotland, gradually evolved all those capabilities which the relics of the graves have shown, as interpreted by the learned author of "Prehistoric Annals of Scotland," that they were finally possessed of.

The third chapter, entitled "Caliban's Island," is again an equal mixture of ethnology and the drama; but the conclusion, leaving Shakespeare's home of Caliban at rest, takes up the question of the home of those hypothetical apes that in their own onward march of improvement are asserted by the evolutionist to have given birth to man. Dr. Wilson cannot see in Borneo an island

suitable for such a process, and denies that such an "Eden" as Hæckel's Lemuria could have existed; but does not give conclusive reasons why such was not formerly the case. How is it possible that the surface of the earth can now be correctly delineated, as it was in the Miocene period, when the first man probably appeared?

Whatever may be the truth of man's origin, it has at least been proved that it has taken unnumbered centuries for man to become what a few of his numbers now are; and, again, that so-called savages are not a result of racial degradation. With these facts, as we consider them, prominent in the mind, as we read of Shakespeare's Caliban, elucidated by Dr. Wilson's ingenious pages, we cannot but think that there is a balance in favor still of Darwin's theory, and that the greater difficulties in the way of absolute proof have not been touched upon by the author of "The Missing Link." — C. C. A.

ORNITHOLOGY OF THE WEST.*—Our notice of Mr. Allen's article has been unavoidably delayed, and even now we can do little more than call attention to one of the most important of the year's contributions to North American Ornithology—a telling paper, worthily succeeding the author's "Florida." As Director of a scientific expedition from the Cambridge Museum, Mr. Allen explored the greater portion of four territories, collected some two thousand specimens of over two hundred species of birds, besides much other material, and made extended observations, especially in the matters of geographical distribution and climatic variation. The range of the species is exhibited by means of eight separate local lists, while a ninth gives a digest of the whole. The faunal catalogues are severally prefaced with topographical, climatic and other data of important bearing and enlarged with various interesting biographical notes.

Questions of variation in specific character according to extrinsic physical agencies are discussed throughout the paper as they successively arise, and, we need not add, with the author's recognized impartiality and ability. The observed facts receive, on the whole, what we believe to be their true interpretation. We have no space to occupy with details, for which we must simply refer to the

* Notes of an Ornithological Reconnoissance of Portions of Kansas, Colorado, Wyoming and Utah. By J. A. Allen. Bull. Mus. Comp. Zool. III, No. 6, pp. 113-183. July, 1872.

memoir itself; but some points of general moment may be briefly noticed. Mr. Allen describes or otherwise records, but without naming, "several well-marked geographical races not previously chronicled;" and claims, as unquestionably he may, "a confirmation of all the general conclusions arrived at in my [his] recent paper on the 'Winter Birds of East Florida.'" Most of these varieties hang upon the law, which we believe Mr. Allen was the first to apply to our birds, if not the first to announce, that, other things being equal, intensity of coloration varies directly with the mean annual rainfall. Its extreme manifestation, in the bleached forms of the American desert, have before been noticed; but its universal operation seems to have been hitherto unregarded. Color-characters of birds are thus correlated with the three leading surface conditions—forest, prairie and desert—and proven due to the same meteorological causes. We believe this law to be one of the soundest and broadest ever applied to the study of birds. Variation in the size of peripheral parts inversely with latitude is a second proposition Mr. Allen has elucidated and sustained by numerous observations; its full bearing is probably yet to be determined, since for the present it lacks the stability and unequivocacy of the other. We find that most of the "new" geographical races noticed by Mr. Allen depend upon one or both of these laws. One of the most noticeable, and, its authorship considered, one of the most unexpected, features of the present paper is the recognition of numerous races by *name*—a mode of treatment that we heartily endorse. As many of our readers know, ever since Mr. Allen applied the entering wedge in the locally famous case of *Turdus Aliciæ*, he has made variation his specialty, and lost no opportunity of showing intergradation of forms once considered specific. It is undeniable that, spurred by enthusiasm of discovery and zeal of earnest conviction, he occasionally overshot the mark—indeed, this present paper shows he is himself aware of this, for he has already taken apart some of the crude synonymical lists that marred "Florida," and given a "name" as well as a "local habitation" to many varieties he formerly ignored. We believe him to be now treading on sure ground, with far less to regret for the past than is the common lot of the advocates of innovations that mean iconoclasm. The past year has witnessed changes in American Ornithology unprecedented since Baird recast the Audubonian model, if not since Wilson took the subject from European

writers to himself—changes not only involving nomenclature and the rest of the machinery, but also profoundly affecting methods of study. It is too early to decide whether the modification was simply the inevitable swinging back of a pendulum that has reached its limit, or whether it was effected—at any rate, hastened—by Mr. Allen's instrumentality. In the latter event, and if the late revulsion proves to be, as it apparently is, a real reform, Mr. Allen's conspicuous connection with the progress of the science at that particular time is to be regarded as singularly fortunate.—E. C.

INTERMEMBRAL HOMOLOGIES.* —Since it is not reasonably possible to do justice to this remarkable paper within the limits to which we are confined on this occasion, we must be content to indicate its nature and scope. This restriction is perhaps the less to be regretted because, as some few of our readers may be aware, our own studies of the same subject have run too nearly parallel with Prof. Wilder's for us to have entirely escaped a bias of judgment unfavorable to impartial criticism; and because we would not even seem to seize an opportunity that the office of reviewer affords of arguing in favor of views that both the author and ourselves desire should be left to stand or fall upon their own merits. Searching criticism can only be expected from those who differ, not those who agree. We are satisfied of the soundness of Prof. Wilder's main views of the vertebrate homologies; and if we are at present unprepared to go with him as far as he has gone, this is chiefly because he appears to have pushed past a certain Rubicon that separates the safe logic of observation from the possibly fallible results of speculation. If we were urged to specify what we believe to be a misconception under which our learned friend labors, we should say it were this, as gathered from his collateral writings; that no mental abstraction, whether moral, æsthetic or purely intellectual, can be formed, unless a corresponding material embodiment exists; and that consequently conception of an idea implies that it has some real physical expression. But there is reason to believe in the existence of a class of ideas, conventionally designated as fanciful, to which this hypothesis has no proven application. One of the clearest and strongest points of the paper

* Intermembral Homologies: The Correspondence of the Anterior and Posterior Limbs of Vertebrates. By Burt G. Wilder, S. B., M. D., etc., Proc. Bost. Soc. N. H. xiv, p. 154, *et seq.*, 1872.

is that made on pp. 15 and 17, where, in the hope of closing "the first century of this [the homological] controversy by proposing a view embracing the best elements of both the two great parties, syntropists and antitropists," the author says: "it is probable therefore, that for a final solution of the problem we must combine the *visual* method of Huxley, as based on the facts of position in the embryo and lower animals, with the *intellectual* method of Wyman, as based upon a great law of organization."

The "historical sketch of the question" with which the article opens is a valuable contribution of the literature of the subject, meriting a more pretentious name, since it is a critical summary of most that has been done in this field — one than which few have been more harrowed with so little cultivation. The author continues with a revised nomenclature of parts and of ideas — a bold attempt to furnish some new tools of thought and sharpen others, the success of which can only be surmised, since this depends more upon acceptability than adaptability. Such words as *meros*, *talus* and *genu* strike one peculiarly, while such as *pseudantitropy* and *hypsesyntropy* demand crystallization of the ideas they foreshadow to command general recognition. Much original evidence of the morphical insignificance of numerical composition is adduced in another portion of the treatise; while several general and special problems are presented for future research. May we not confidently look for their solution by an author who has proven himself an earnest, impartial and meritorious investigator? A chronological list of works bearing on the subject, invaluable for reference, closes an article of signal pertinence and acceptability, which becomes at once indispensable to students of philósophic anatomy, and which may not improbably be hereafter recorded as one marking an important period in the progress of that study. — E. C.

Revision of the Echini.* — This superbly printed and lavishly illustrated work is another of the series of Illustrated Catalogues issued by the Museum of Comparative Zoology. It is a general work on the living species of Echini, and from the evident care in its preparation, combining the results of the study of the types of most of those who have written on this order scattered through

* Illustrated Catalogue of the Museum of Comparative Zoology at Harvard College. No. vii. Revision of the Echini. By Alexander Agassiz. Parts i-ii. With 49 plates. Royal 8vo. pp. 378.

all the principal museums in Europe as well as our own country, it must for many years be the standard work on this subject.

The first part contains the bibliography, followed by a chapter on "Nomenclature, which will greatly interest special students in zoology, and we only wish we had room to reprint certain portions. Mr. Agassiz finds that the value of the genera usually recognized, "when tested by our present knowledge of the changes they undergo seems limited almost to convenient headings or keys for the more ready identification of species. Genera, as we recognize them among Echini, are certainly not founded upon features of general and permanent value, but, on the contrary, upon features applying only to a few species, and of very limited application." "In spite of the definite existence of what we call species, genera, etc., when we apply these terms to limited regions and series of the present day, yet we find them totally inadequate to express our wider interpretation when our standards of comparison are infinite in time or space." In illustration of this idea expressed of the shifting nature of generic characters, if we understand our author aright, he says in the preface to his second part that "the number of fossil genera has been increased to such an extent, and they have been based upon features which are here shown [by the study of the young of existing species] to have so little value, that before we can make a satisfactory comparison of the fossil species with those now living, a thorough reëxamination of the fossil Echini from our present standpoint is absolutely necessary."

The "chronological list" contains the history of the names of the different forms of Echini; 116 pages are devoted to synonymy. An interesting chapter on "Geographical Distribution," ends part I. In it he advocates "Lovén's theory of the distribution of life, — of a uniform fauna throughout the bottom of the deeper parts of the Atlantic."

Mr. Agassiz thinks that we now have a very fair representation of the littoral Echini of the world, and as recent explorations indicate that we have hitherto inadequately mapped out the probable distribution of life at great depths, he would wait for the results of such explorations before discussing the subject. He finds that the distribution of sea urchins agrees remarkably with the "great belts of temperature first mapped out by Dana;" and copies them on the seven suggestive maps bound in before the plates.

The second part consists of descriptions of the Echini of the Eastern coast of the United States, with a report on those collected by Pourtalès in the deeper parts of the straits of Florida.

The forty-nine plates are lithographs, Woodbury types and Albertypes, and each is used with great success in delineating these forms so difficult to render, and expensive both as regards time and money. For such objects as Echini photography proves invaluable.

AFRICAN ORNITHOLOGY.* — Those who are interested in this subject will welcome this as a very convenient and useful volume, the entire reliability of which is assured by the author's evident familiarity with the birds treated, as well as by the able critical editorship of his manuscripts. It is likewise a comprehensive treatise, four hundred and twenty-eight species being included. Specimens of nearly all of these have been reëxamined and identified by Mr. Gurney, to whom we owe their nomenclature and arrangement, as well as the technical portions of the work, Mr. Andersson's portion being that of a naturalist in the field. The complete title of the work, below quoted, sufficiently shows its plan and scope, while general praise of the mode of execution would be entirely superfluous. A point of interest for American ornithologists is the authentic record of *Tringa Bairdii*† as a bird of South Africa.—E. C.

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* Notes on the Birds of Damara Land and the adjacent countries of south-west Africa. By the late Charles John Andersson, author of, etc. Arranged and edited by John Henry Gurney, with some additional notes by the editor, and an introductory chapter containing a sketch of the Author's life, abridged from the original, published in Sweden. London. John Van Voorst, 1872. 8vo, pp. xlviii, 394.

† Mr. Harting's supposition that this species has never been figured is not quite correct. Soon after its original description, a life-size colored plate of two figures was executed, I think by Mr. Cassin, in Philadelphia. I had proofs in my possession for sometime before I lost them, and I believe there are others extant in the Smithsonian. But I had nothing to do with the matter, never knew for what, if any, work the plate was intended, and cannot say whether or not it was ever published. The following summary, probably approaching completeness, of the literature of the species, is subjoined for convenience of reference:

? *Chorlito lomo negro* AZARA, sec. Scl. et Salv.

? "*Tringa melanota* VIEILLOT."

? "*Tringa dorsalis* MEYER *et* LICHT."

? *Tringa pectoralis* CASSIN, Gilliss' Exp. 1855, ii, 195.

Tringa Schinzii WOODHOUSE, Sitgreave's Exp. 1853, 100, Excl. syn., nec Brehm.

Tringa Bonapartii CASSIN, Baird's B. N. A. 1858, 722 (*partim*) nec Schlegel. HAYDEN, Geol. & Nat. Hist. of the Upper Missouri, 1862, 174. ("Water courses of the Northwest.")

Tringa maculata SCHLEGEL, Mus. Pays-Bas, *Scolopaces*, 1864, 39 (*partim*).

Actodromas Bairdii COUES, Proc. Phila. Acad. 1861, 194. ("N. Am., E. of R. Mts.") —

NEW SPECIES OF AMERICAN MOTHS.*—Mr. Grote is still supplying us with descriptions of our moths, which will make their study all the easier for students. We cannot agree with him in placing (after Lederer's example) the species of Hypena and indeed all the "Deltoids" among the Noctuids, believing that they run into the true Pyralids, whether we consider the larval or adult characters.

Unfortunately for lepidopterists the second paper we notice is but a fragment. It is a mere outline of an extended memoir in which all the North American species known to the author as belonging to the genus Catocala were fully described. This paper was lost in transportation. This beautiful genus, says Mr. Grote, "seemed to have its largest representation in North America, and to attain with us its fullest development." Fifty-four species are described.

ILLUSTRATIONS OF NORTH AMERICAN ENTOMOLOGY.†—We have before alluded to the beautiful and useful plates which Mr. Glover has for years past been preparing, and now only regret that more copies of the present work have not been struck off. The volume before us is one of the most important works on entomology that has appeared in this country. On the thirteen large plates are crowded admirable colored figures of every kind of grasshopper and allied forms that Mr. Glover has been able to obtain, either from his own cabinet or those of his friends. They are authentically named, according to Scudder's catalogue, and need scarcely any letter-press to enable them to be determined by the young entomologist.

The text accompanying these plates, besides giving full explanations of the figures, contains concise notices of the habits of

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ID., *ibid*, 1866, 97. ("Whole interior of N. Am.")—SCL. P. Z. S. 1862, 369. ("Mexico.")—DALL & BANN., Trans. Chicago Acad. 1869, 292 ("ALASKA.")—ALLEN, Bull. Mus. Comp. Zool, iii, 1872, 182. ("Colorado.")—HENSHAW, Am. Nat. vi, 1872, 306. (Long Island, Mass.")

Tringa Bairdii SCL. P. Z. S., 1867, 332. (Santiago, Chili.")—ID. et SALV. *ibid.*, 1868, 144. ("Conchitas, Argentine Republic.") (Other recorded S. Am. localities are Panama, New Granada (*Salvin*) and Tambo, Peru, (*Whitely*;) fide HARTING, NEWTON, P. Z. S. 1871, 57. (Egg.)—HARTING, Ibis, 1870, 151, et apud ANDERSSON, B. Damara Land, 1872, 306 (Walwich Bay, S. W. Africa.)—GRAY, H.-L. 1871, iii, 49, No. 10308.—COUES' KEY N. A. BIRDS, 1872, 255.

*On the North American species of Catocala. Jan., 1872, 8vo. pp. 28. Description of North American Noctuidæ, No. 2. Sept., 1872. 8vo, pp. 19. By A. R. Grote. (From the Transactions of the American Entomological Society, vol. iv. Philadelphia.)

† Illustrations of North American Entomology (United States and Canada). By Townend Glover. Orthoptera. Washington, 1872. 4to with 13 plates, pp. 12.

these insects, and an alphabetical list of the vegetable and animal substances injured by them.

It will be of great use to agriculturists, and when the author feels tempted to issue an edition for the public (the present edition of fifty copies is intended for distribution among entomologists and entomological societies only) we are sure that the work will be highly valued.

Mr. Glover proposes to "publish yearly, or from time to time, additional plates, etc., of the same size and in similar style, of any new or rare Orthoptera which may be added to our list by the expeditions or by private enterprise, as likewise, eventually to illustrate all the other orders of insects in a similar manner."

THE FORMS OF WATER.* — Prof. Tyndall leads off in the admirably projected "International Scientific Series," which we owe to the earnest efforts of Prof. Youmans, and the energy and liberality of the Messrs. Appleton. We are so late in noticing the present attractive volume that probably most of our readers have bought it. Those who have not seen it have a rare treat in store, as it fully equals Tyndall's other works in the lucidity and interest of its style, and is of special value as giving in a simple, condensed form the views of the pioneers in glacial studies. The series comprises a large number of subjects to be treated by the leading scientists of the old and new world, and when completed will form an admirable library of science.

PHYSICS AND POLITICS.† — This little volume, consisting of six essays, may fairly claim, we think, to be considered a valuable addition to anthropological literature. It certainly is strictly scientific throughout, and commends itself, by its clear statements of facts, to the intelligent reader. It is not merely an outline of the works of others, or an attempt to popularize the history of the human races of prehistoric periods.

Mr. Bagshot takes up the subject of the very early condition of mankind, and while viewing him in a light quite different from that either of Lubbock or Tylor, yet draws the same conclusions: and

* The Forms of Water in Clouds and Rivers, Ice and Glaciers. By John Tyndall, LL.D., F.R.S. With thirty-five illustrations, etc. New York, D. Appleton & Co. 1872. 12mo, pp. 192.

† Physics and Politics; or, Thoughts on the application of the Principles of "Natural Selection" and "Inheritance" to Political Society; by Walter Bagshot, Esq., New York: D. Appleton & Co: being the Second Volume of the International Scientific Series.

brings forth more facts for the theory, now established, that man's original condition was one of barbarism — one, in which, the bestial predominated. This theory, in fact, needs no further demonstration, and may be said to be accepted by the scientific world.

The essence of the argument of the first two essays is that man early secured a modicum of law, as shown in selecting one as a leader; and as that tended to bind together each little community, so it became powerful and warred successfully with the neighboring men, who were held in no restraint, by the *natural* selection of one of superior parts, who would be a leader, by the admiration he caused among his fellows.*

When this "law" was powerful enough to make men mere facsimiles of other men, progress was at an end — the imperfectly developed civilization crystallized. "Progress," he says "is only possible in those happy cases where the force of legality has gone far enough to bind the nation together, but not far enough to kill out all the varieties and destroy nature's perpetual tendency to change."

This argumentation is carried out more fully in the following chapters on "Nation making" and the "Age of Discussion;" and as the author never loses sight of the theory of evolution, "which, if it be not proved conclusively, has great probability and great scientific analogy in its favor," it is interesting and instructive to the scientific reader to see these principles, which are so generally applied to mere genera and species, successfully, we think, handled in the elucidation of some puzzling anthropological problems. — C. C. A.

POPULAR SCIENCE MONTHLY.†—After carefully reading this journal, since its first appearance nearly a year ago, we can say that it is doing a good work for science in this country by commending the labors of scientific men, and raising the minds of the laity into the scientific atmosphere. Scientific thought is something distinct from the average thought of our age and people, whether expressed

*Mr. Bagshot only proposes to explain how the various nations may have arisen, and not how the well worked races became so distinctly characteristic as they are. This subject he touches upon, but only to refer to it. There seems much probability however in the suggestion, that natural selection, in races, as in nations, produced the differences as they now exist, but it may be, at an earlier period, when mankind was more pithecoid in his nature.

†The Popular Science Monthly. Conducted by E. L. Youmans. New York; D. Appleton & Co. 8vo. Each number 128 pp. With illustrations.

in our commercial, literary or religious papers. It is the mental air that Galileo, Goethe, Newton, Kant, Linnæus, Cuvier, Rumford, and the scientific lights of our own day have created; and nothing but sound mental health, a hearty love of truth, and greater happiness will result from breathing such air. Science is the expression of the common sense of all ages. It tends more than any other study to develop common sense in the individual.

This journal does not cultivate a special department of science but aims at persuading men that science is to be cultivated not only for its own sake, but as directly increasing human health and happiness.

The only fault we have to find is that the papers, most of which are selected from the scientific thinkers of England, do not perhaps fairly represent American thought, for certainly we have men of as much ability as the authors of many of the papers that have been reprinted in this journal, could they be induced to write. Again in the department of Reviews is an excellent opportunity, of which due advantage is not taken, of eliciting the best thought of our working chemists, naturalists, geologists and astronomers. American scientists have a duty to perform in impressing the value of science upon our politicians and rulers. We believe in the Platonic marriage of Science and the State.

HALF HOUR RECREATIONS IN POPULAR SCIENCE.*—This admirable series of reprints contains papers entitled "Strange Discoveries respecting the Aurora and recent Solar Researches," by R. A. Proctor; "the Cranial Affinities of Man and the Ape," by Prof. R. Virchow; "Spectrum Analysis Discoveries," by the editor; "Nebulæ, Meteoric Showers, and Comets; and Unconscious Action of the Brain, and Epidemic Delusions," by Dr. Carpenter. Prof. A. Winchell has prepared a number on the "Geology of the Stars" which is in press. This series is to be followed by the publication of "Half Hour Recreations in Natural History," to consist of several volumes, entitled "Half Hours with Insects, with Birds, Wild Animals, Domestic Animals, Reptiles, Plants, Trees, and Fishes. Each volume is to be carefully prepared by an expert. We are glad to have such works freely disseminated. They are popular in style and will be found to be very readable by persons not versed in science.

* Half Hour Recreations in Popular Science. Dana Estes, editor. Estes & Lauriat, Boston. 12mo. Each number 32 or 36 pages. With illustrations.

A New Theory of the Origin of Species.* — We have here an essay illustrative of the general principle, that confidence in the discussion of great problems of modern science is in inverse ratio to a knowledge of details. The author has undertaken as his first work to handle the most difficult of scientific problems, commencing at the top instead of the bottom of the scale of work which the student must pursue in order to reach conclusions which rest on a solid basis. The result is naturally a production scientifically worthless. His theory, that each new specific form is produced from the matrix of a preëxistent species by supernatural creative power, is only a form of the old belief in distinct creations, and is not a developmental theory in any sense. He produces no evidence in support of it; in fact, he does not appear to know what scientific evidence is. This further appears in the inconsistency of his belief in the development of species by descent. In evidence of this he cites the arguments adduced by some well known European authors, with reference to the succession from less to more perfect, exhibited by classification and palæontology. With the works of American scientists he appears to have little or no acquaintance. Occasionally, novel and erroneous statements are made; *e. g.*, "The Icthyosaur is between the predaceous fishes and the crocodile!" "In this era the fierce Saurians make their appearance in the *Megalichthys hibbertii!*" Trilobites are defined as "a three lobed animal, in general figure something like the wood-louse." The *Mosasaurus* "a huge reptile twenty-five feet long" is referred to the *Eocene* formation (!) and is said to be "intermediate between the *monitor* and the *Iguana.*" A slight knowledge of American palæontology would have prevented such blunders. The early part of the paper is occupied by arguments of the popular sort against descent by generation. He lays especial stress on the size of the human brain as compared with that of the apes, forgetting that the canary's brain is relatively still larger than that of man.

The author expresses himself clearly and distinctly, and we hope that his pen may in future find abundant occupation in relating his studies into the structure, embryology, and other details of biology, which are essential to the discovery of the laws of creation. In this we prophesy for him success. As it is, he is now evidently

* A New Theory of the Origin of Species. By B. G. Ferris, New Haven, Conn. Chas. C. Chatfield & Co.

a book zoologist. Work in the shop (which we hope he will undertake) will correct his views and give him a place among his friends, American zoologists. In the meantime let him look up the orthography of the words carnivorous and herbivorous. — E. D. C.

BOTANY.

Cultivation of California Roots and Bulbs. — In a climate like ours, clearly discriminated by a wet and long dry season, we find these bulbs located say about six to ten inches deep; the vital fibres, or true roots, shoot downwards ten inches to a foot below this point, in search of food and moisture: thus radiating from the leading germinal end of mostly oblong scaly bulbs — the respectively dormant fibres that have "closed in" serving as stays, etc. Is it not evident, then, that such bulbs require a flower pot at least eighteen inches deep? Hence, ordinary pots must be *utterly useless*, cramping the plant, or inadequate to meet its primary natural indications. Let any one take an improvised five-gallon kerosene or alcohol tin can, or the like, which is good enough, not to say the best, cut out one end and nail narrow slats around the upper margin to add symmetry, avoid unsightly dents, and for convenience in handling; and if one slat is dressed, paint the name, to avoid annoyance of displayed labels; paint rudely inside and out, to preserve; punch say at least three large holes in the bottom; plant, as in nature, in any good soil well composted, and set your can, keg or crock, *in a shallow pan of water*. You will soon have the pleasure of seeing a stout stem, of the size of your thumb, rising up and "rejoicing as a strong man to run a race," and flowering gorgeously. Let it generally be observed here, once for all, that in California *underground* irrigation, or water supply from beneath, is the requisite rule or law to be observed, especially in their advanced stage of growth. Many California plants are not only injured but killed outright by spraying beneath our California sun. To illustrate these principles, let us take a few other examples, to show that if a plant spends its vital force searching for requisite food or moisture; or, if the law of supply be reversed, efforts balked, or attained at too great an expenditure, little or nothing else can be accomplished. *Abronia arenaria*, as the specific name indicates, grows in sand. If found on deep sand-drifts of the bay shore of San Francisco, or inland, it shoots down a stout fusiform

root of indefinite length; but often poor and puny is the top, that creeps not far from the crown, with perhaps few flowers and little fruit. But mulch a moist, black, brackish, cracky soil, with only six or eight inches of sand, and it will go down to, or a little into it, spreading abroad its forked subdivisions and fibres, almost or quite horizontally; the crown-sprouts now run riotously, mantling the sand with vines, full of pink flowers in fruitful umbels unnumbered. Often one spray of water *above* will kill it entirely; or, the róot remaining, it will sometimes come up and flourish again if surface irrigation is neglected, even *two years* afterwards. A similar short horizontal spread of root is seen with *Alfalfa*, on tule or lands fairly shaking and rocking with a peaty carpet; and so of a thousand roots, otherwise exceedingly deep, and prone to delve. The legitimate practical inferences we leave to the good sense of every enlightened stock-raiser, farmer and cultivator.

Florists are apt to complain that many of our bulbs ere they bloom lose one essential beauty of plants, namely, their *radicle leaves*, which, they say, "dry up, and leave the stems looking naked and bare. They are frequently found upon exposed hills and slopes, rocks, etc., descending down dry and very hot valleys, into debris and alluvial bottoms, where sand or loam with *underground moisture* abounds. The very same plants are seen to rejoice best where they find some shade and shelter; otherwise, they bespeak a struggle for existence, *i. e.*, their leaves prematurely or naturally dry up early to save exhaustion. In half shades, along high banks and slopes, contiguous to creeks, with adequate subsoil moisture, we see *Cyclobothra alba*, with long and beautiful glaucous leaves, say an inch and a half wide and eighteen inches to two feet in length, accompanying the flowers, ten to twenty in number; the golden *C. pulchella* and most others tolerate more sun and drought, with their companions the manzanita (*Arctostaphylos glauca*), oaks, etc., near whose shades it is wont to linger; but its best forms love rich, rocky, half shady drains — leaf and flower companions to the close. Witness *Seubertia laxa*, two to four feet high; the same *Dichelostemas* and *Brodiœas*, with ten to fifty flowers, and green leaves in similar grace and completeness of beauty. The list might be extended beyond the reader's patience; what we desire to say and impress is, that the same plants exposed are barely one quarter as large, and with no green leaves at all, or at best a poor apology for them; and so of numberless others.

Erudite and complex recipes relative to proper mixtures of soils, and common management may well be left to the knowledge and judgment of those who believe in them. With such a wealth of sunlight and heat above as falls to the lot of California, and no lack of the commercial medium, moisture, below, I see no reason why we may not allow Nature, under human hands, to grow her fragrant white Lady Washington lily six or seven feet high, with ten to thirty or more flowers, just as we see it wild. *L. Bloomerianum*, too, is a perfect giant among lilies, when at its best — a right super-royal display — the Divine Teacher himself being judge. Nor why *L. superbum* in a southern bog should be eight feet high, with the best part of a hundred flowers, as we have seen it there, and still the marvellous beauty is ever new as we retrospect. Even our *little* orange *L. parvum*, I found at the Sierra summit over five feet high and fifty flowers — *carefully counted* — but the plant was sheltered and shaded by an old emigrant water-tank stilted up, now dry and long ago abandoned, but its roots found a fair supply of *water from beneath.* — Dr. A. Kellogg, *in the California Horticulturist.*

On Drought in its Relation to Winter-killed Trees.—I was pleased to note how near Prof. Shaler, by a single season's observation (see Vol. vi, p. 671), came to a correct theory of arborescent destruction in winter, which it took me some years to discover after a comparison of numerous facts, — namely, that trees commonly hardy, when they are killed in winter, are destroyed by evaporation, in the same way that they are by drought in a dry summer.

In my younger horticultural days, if any one had given thought at all to the process of destruction, it was to believe that frost expanded the sap in the cells which consequently became ruptured, just as frozen liquid splits a bottle. It fell to my lot to combat this view, and to show that it was evaporation and not expansion. I need not here detail the facts on which this law has been founded. The readers of the "Gardener's Monthly" are familiar with them, and a reference to the Index of the past twelve volumes will readily direct others who have been outside of the horticultural pale, for it is essentially a field for the observing horticulturist to cultivate.

Prof. Shaler was quite right in doubting whether it was the intensity of the cold alone which destroyed the trees, but he is not

quite in accordance with the fact in his suggestion that it was after the frost left the roots that the injury began. If Prof. Shaler will remember that there is an enormous evaporation going on from plants exposed to a dry atmosphere, and that this takes place whether there be frozen soil about the roots or not, he will I think understand how a plant may become exhausted of itself, without waiting for the thaw. If there be a very dry atmosphere, and the roots nearly all encased in frost at the same time, it is still more difficult to supply this waste. The deeper the frost the greater the difficulty, and the more evaporating surface, as in evergreens, the greater the risk.

The destruction by drought and not by the absolute degree of frost being conceded, there remains nothing but to apply the law to general science as Prof. Shaler suggests; a dry atmosphere becomes a destructive agent as well as frost, and those plants which part with their moisture the most readily, as a climate passes from moist to dry, must be the first to disappear. In my grounds I had large quantities of American hornbeam side by side with the English species. These last were all killed to the ground,— the others uninjured. This shows that the American species can resist evaporation better than the European. It is difficult to decide from an evolutionary point of view which of these two very closely allied species had the priority of origin. If we accept the proposition that in water was the beginning of plant life, we might infer that development has been in the direction of the dry atmosphere, and thus arrive at the conclusion that by natural selection the American is an offshoot from the European. In my grounds also the Liriodendron suffered terribly. I had ten thousand from one to five feet high killed to the ground, but all above this were uninjured, as their roots were deep in the ground, and could supply the waste of sap without much destruction from the frost. But the fact of the younger ones drying up so easily, shows that this tree was not created for a dry winter climate. We must infer that they are either immigrants, or that the climate has changed since their first appearance. And then again arises another suggestion. Suppose the future seasons should regularly repeat the last, would "natural selection" be sufficient to produce some less liable to loss by evaporation, as we have supposed may have been the case with the hornbeam? Would this change to a greater winter aridity, if continuous, give rise to a new species of Liriodendron?

These are some of the thoughts suggested by Prof. Shaler's paper. They are mere "speculations" it is true, but the imagination, under proper control, is a great aid to investigation. If we suspect something we may be led to look for the evidence; and thus learn long before those who wait to stumble on the truth.— T. Meehan.

Influence of Foreign Pollen on the Parent Plant:—Professor Gray adds (Amer. Journ. Science and Arts, Dec., 1872) another to the already numerous instances, says the "Academy," which have placed this mysterious phenomenon beyond dispute. An apple (Spitzbergen) produced a fruit half of which was (at least as to the surface) Spitzenberg, the other half russet. A tree of the latter fruit stood about two hundred yards off. The division into two exactly equal parts is quite unexpected; as the styles and carpels were five, we should have expected the division to be into fifths. Moreover, the action of the pollen in this case is, morphologically, on the calyx, not on the pericarp.

We have been told on excellent authority that apples have been raised in Hopkinton, Mass., which were half sweet and half sour, the line of demarcation being very distinct, so that the distinction in this case was more than skin deep.

[The apple in question was received from the Smithsonian Institution, with an account of its history, and a statement that one or more similar apples had been already received at the Agricultural Department, Washington, and preserved in wax models. Although the external line of demarcation was perfectly distinct, we are bound to add that, on cutting it up and distributing portions among the members of our botanical class, about half the tasters pronounced the morsels to be russet which were taken from the Spitzenberg side of the apple, or *vice versa*. But the fruit was hardly ripe enough.—A. G.]

ZOOLOGY.

A New Species of Sparrow.—Ornithologists will be interested to learn of the recent discovery of a sparrow belonging to the genus Centronyx, a genus heretofore represented in collections only by the unique type of *C. Bairdii* collected in 1843 by Audubon. The sparrow in question has been minutely examined and compared with the above mentioned type of *C. Bairdii* by Mr. Robert

Ridgway, of the Smithsonian Institution, who has kindly furnished me with the results of his examination.

The following is a description of the bird.: —

CENTRONYX OCHROCEPHALUS Aiken.—Specific characters:—ground-color of the head deep ochraceous, deepest on top, and gradually fading to buffy-white on the throat; feathers of the crown with broad medial stripes of deep black, these narrower and sparser medially, so as to produce two dusky lateral stripes, and a light medial one. A distinct black spot behind the upper posterior corner of the ear-coverts, a smaller one at the middle of their posterior edge, and two black stripes bordering the light ochraceous maxillary one, a narrow rictal stripe along the lower edge of the ear-coverts, and a heavy "bridle" on each side of the throat.

Lower parts buffy-white, purer posteriorly; jugulum crossed by a series of heavy cuneate streaks of deep black, these continuing backward along the sides, but becoming reddish on the flank. Dorsal feathers hair-brown, with black centres, and broadly bordered, both laterally, and terminally, with creamy-white; rump and upper tail-coverts similar, the feathers with black shaft-streaks. Wings reddish-gray, the feathers blackish centrally. Tail-feathers black, skirted with pale ochre-grayish, this becoming pure white on the outer pair of feathers on each side, the exterior of which are pale gray centrally.

Wing, 3·00; tail, 2·40; culmen, ·45; tarsus, ·85; middle-toe, ·63; lateral toes, ·20 shorter; hind-toe, ·35.

Habitat.—El Paso County, Colorado.

Though evidently closely related to *C. Bairdii*, this bird seems to differ specifically in quite different proportions, and also apparently, in different coloration, though the type of *C. Bairdii* is in such worn and faded plumage, that its perfect dress cannot be ascertained satisfactorily.

The differences of form and proportion between the two species of Centronyx are as follows: —

C. BAIRDII. Tail doubly-rounded, the lateral feather as short as the middle one, and about ·20 shorter than the longest; wing, 2·80; tail, 2·10; culmen, ·50; tarsus, ·90; middle-toe, ·60; hind-toe, ·40; its claw, ·40.

C. OCHROCEPHALUS. Tail deeply emarginated, the lateral feather longest, and ·20 longer than the middle; wing, 3·00; tail, 2.40; culmen, .45; tarsus, ·85; middle-toe, ·63; hind-toe, ·35; its claw, ·30.

Of the habits of the bird, I can at present say but little; the single specimen obtained, was found on the dry open plains, many miles from timber. Its actions appeared to resemble those of *Coturniculus passerinus*.—C. E. AIKEN, *Fountain, Colorado.*

INSTANCE OF SAGACITY AND AFFECTION IN A DOG.—On the afternoon of January 4th, Mr. F. W. Crosby of this place, while walking along the bank of Clear Creek, observed two dogs. A black Newfoundland dog (male) and a small white dog (female) playing together on the ice in the creek. While Mr. Crosby's attention was diverted for a moment the white dog disappeared from sight,

having fallen through a hole in the ice, and the black dog was working with might and main to make a hole through the ice several feet below where his mate fell in.

The creek at this point is shallow and quite rapid, so the dog was carried down stream but a few feet and lodged against a stone.

Mr. Crosby not realizing then the true condition of things, or that he could be of any assistance to the drowning dog, passed on.

Returning by the same place in about half an hour, he noticed that the black dog had succeeded in making a hole through the ice, had drawn his then dead companion from the water, and stood over her, as if trying to warm the lifeless body. The ice where the dog made the hole was one and one-half inches thick and strong enough to bear a man. The dog worked with such energy as to cut his feet and mouth quite severely.

This occurred about 5 P. M. The next morning the dog was still on the ice walking slowly back and forth near the body of his companion, and he had evidently remained there during the whole night, although it was very cold and stormy. — W. O. C.

THE FOOD OF DIPTERA. — That certain kinds of flies, especially many belonging to the order of Syrphidæ, live to a great extent on the pollen of plants, was first pointed out by Dr. Herm. Müller of Lippstadt (see NATURALIST for July, 1871, p. 390), who described the process by which they accomplish the chewing of the pollen-grains and the severance of the threads by which they are frequently held together, by means of minute denticulations at the end of the proboscis. This statement is in opposition to the views of many entomologists, who hold that, not being provided with mandibles, the Diptera must depend mainly or altogether on fluids for their nourishment; but it has recently been confirmed by the observation of some English naturalists. Mr. A. W. Bennett has examined under the microscope the contents of the stomachs of several Syrphidæ, especially *Eristalis tenax* and *Syrphus arbustorum*, and finds them loaded with pollen-grains belonging to some composite plant, presumably an Aster; and one of the first English entomologists, Mr. Edward Newman, states in the "Entomologist" for January that "Eristalis feeds chiefly on pollen, and most of the Syrphidæ follow its example; the common house-fly eats various solids, and masses of these substances may be found in

the stomachs of these Diptera undissolved and unaltered after passing through the entire length of the leathery and extensile proboscis."—A. W. B.

NOTE ON CASSIN'S PYRRHULA.—Ornithologists have generally accepted the *Pyrrhula Cassini* Baird from the Yukon region, Alaska, as a valid species, the essential character consisting in the absence of red on the part of the male, and the elongated white spot on the outer tail feather. In a communication presented at the eighteenth meeting of the German Ornithologists' Association, Dr. Cabanis referred to a *Pyrrhula* from Lake Baikal, having very much the character of *Cassini;* and at a meeting of the society held in Berlin, on the 3d of June, 1872, this determination was re-affirmed by Cabanis, in the strength of three specimens lately received from Baikal precisely like the Alaska species, previously described. The bird is said, indeed, to be quite abundant, and its occurrence in Siberia, therefore, removes the difficulty which was felt in assenting to the existence of a purely American species, of a genus that is eminently characteristic of the Old World.

In the same communication by Dr. Cabanis, it is stated that Cassin's Bulfinch was also to be accounted as a bird of Europe, since reference is made by Wickevoort Crommelin, in the *Archives Neerlandaises*, to a bird, killed in a flock of *Pyrrhula vulgaris* in Nov., 1866, which differed from the rest in having an elongated white spot on the inner edge of the outer tail feathers. (Cabanis' Journal, 1871; 318; & 1872; 315.)—S. F. B.

HYLA PICKERINGII IN WINTER.—Mr. Samuel P. Fowler, of Danvers, Mass., has sent us a beautiful fawn colored specimen of the little spring piper, or Hyla, which he found, on November 29th, embedded in a heap of grass sods in his garden. We know nothing of the winter habits of our Batrachians and every fact of this kind should be put on record.

APPLICATION OF THE DARWINIAN THEORY TO BEES.—Hermann Müller publishes, in the "Transactions of the Natural History Society of the Prussian Rhineland and Westphalia," an elaborate paper of about a hundred pages octavo, under the above caption. We have already given in the NATURALIST the exceedingly interesting paper by this author from the Italian version, with notes by Prof. Delpino. Space only allows us at present to briefly notice

the chief points made in this second longer article. The object of the present memoir is to show "how in the bees a comparison of those peculiarities of organization which have marked them as useful in aiding the bee in seeking flowers, give us a certain clew in seeking for the ancestry of bees, and the branching out of their genealogical tree."

The memoir is divided into six sections, with the following heads:—

"1. Bees differ from the fossorial wasps only through such peculiarities of organization as adapt them for collecting the pollen of plants and making honey.

2. The above stated peculiarities of bees, which adapt them for gathering pollen and making honey, thus bringing about the differences between them and the fossorial wasps, offer but a slightly interrupted series of modifications from those presenting the most striking differences, to those which in their organization scarcely differ from fossorial wasps.

3. The bees have thereby so branched out as independent families from the fossorial wasps, that certain species are circumscribed to the maintenance of their brood upon honey and pollen. When this limitation became a hereditary trait, there began a differentiation of their posterity, and so extensive opportunity for the firm establishment of manifold adaptations for the most advantageous mode of collecting pollen and honey. Numerous breaks in the series of relationships of bees have hereby become established through the adoption of new habits relating to the care of their young.

4. The branching off of the bees from the fossorial wasps, and the division of the family of bees into special branches, have resulted merely from the modifications in the structure of the females. Importance of secondary sexual differences for the recognition of connection by relationship of genera and species. Preliminary view of the same.

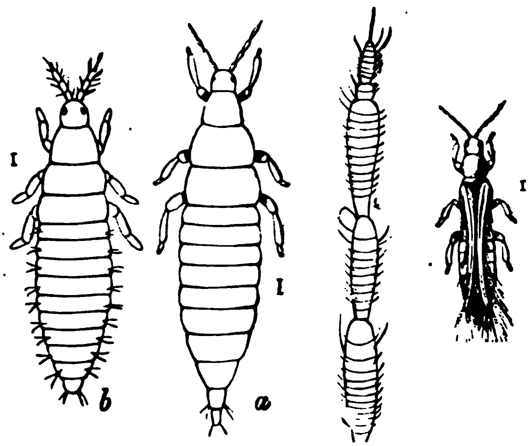
5. Numerical relations of males and females. Qualifications of the males which aid them in seeking the females. Peculiarities of the male antennæ. Why the antennæ are to be regarded as organs of touch and hearing. Peculiar kinds of motions of males.

6. In former times the efforts to effect sexual union brought about secondary sexual peculiarities."

THE THICK-BILLED GUILLEMOT. — A specimen of *Uria arra* Pallas was shot on the Lamoille river, at Fairfax, Vt., about the middle of last December. The bird was nearly full-grown and in good condition. So far as I know this is the first instance of the capture of this bird in New England, except along the shores of the northern portion. — G. H. PERKINS.

Injurious Insects.—In the last report (1872) on the "Injurious Insects of Mass.," made to the Board of Agriculture, some facts are brought out that may interest entomologists as well as farmers.

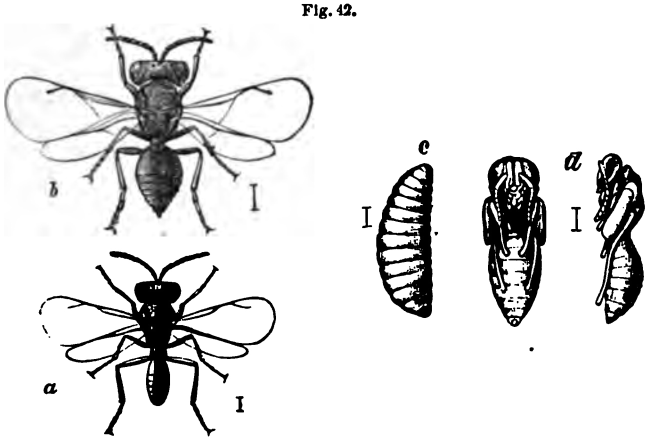
Fig. 41.



Onion Thrips.

A grievous pest to the onion crops of Essex county is the *Limothrips tritici* of Fitch, who found it on the blossoms of wheat and

Fig. 42.



Parasite of Cabbage Caterpillar.

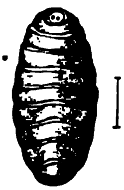
clover. The insect* occurred in all its stages (Fig. 41, male, and end of antenna of male; *a*, female; *b*, larva) on the leaves of

* We are indebted to the kindness of Hon. C. L. Flint, Secretary of the Board of Agriculture, for the loan of these cuts, from the Annual Report on Agriculture for 1872.

onions, and by puncturing them, destroyed about $10,000 worth of this valuable crop in Essex county alone in the summer of 1871.

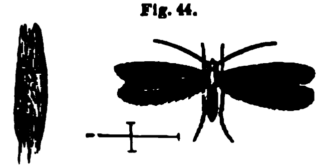
The parasite of the imported cabbage caterpillar is described and figured (Fig. 42, *a*, male; *b*, female; *c*, larva; *d*, front and side view of pupa). To Mr. A. G. T. Ritchie of Montreal is due the credit of first making known the history of this invaluable insect. We have raised many of them from the caterpillars in the autumn. It is the *Pteromalus puparum*, and has been known to be a native of Hudson's Bay Territory since 1844, so that it could not have been introduced with the *Pieris rapæ*, its host.

Fig. 43.



Tachina larva.

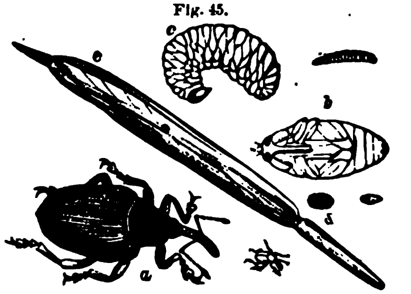
Fig. 44.



Cabbage Web Moth.

Fig. 43 illustrates a Tachina parasite of the same butterfly found by us at Salem. Its imago is unknown. The cabbage web moth (Fig. 44, with cocoon), which is sometimes so destructive, is no-

Fig. 45.



Radish Weevil.

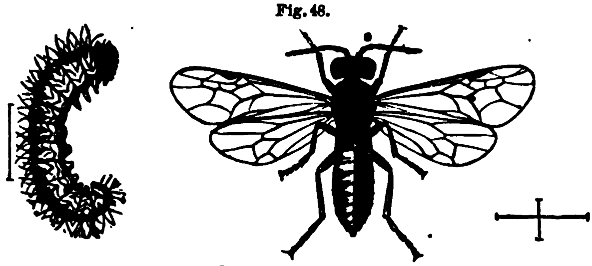
Fig. 46.

ticed; also the radish weevil (Fig. 45 from Curtis, illustrates the different stages of the European *Ceutothynchus assimilis*). It is thought that an example (Fig. 46) found about fifteen years ago by the writer, on the radish, in Maine, belongs to this species. In Europe it is said to be very destructive.

Another beetle likely to prove annoying, as we have found it in ferneries and gardens, and which in England is said to be a "dreadful pest in gardens," is the weevil, *Otiorhynchus picipes* (Fig. 47).

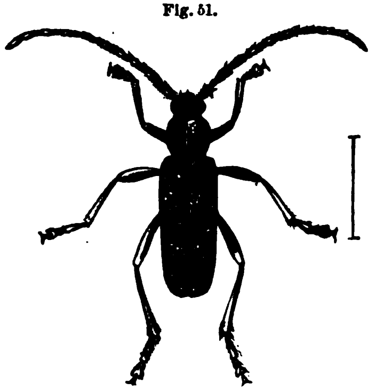
The raspberry saw fly (Fig. 48) is noticed, and the chestnut weevil (Fig. 49), which is thought to be the larva of a species of Balaninus, related to *B. nasicus* (Fig. 50).

Fig. 48.



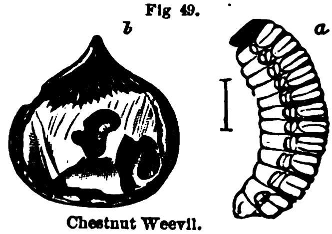
Raspberry Saw Fly.

Fig. 51.



Chestnut Borer.

Fig 49.



Chestnut Weevil.

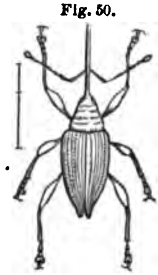
Fig. 47.

Garden Weevil.

Fig. 52.

Elm Borer.

Fig. 50.



Balaninus.

INJURIOUS INSECTS.

The chestnut tree has been found to be tenanted by the larva of *Arrhopalus fulminans* (Fig. 51) while a new borer of elm trees has been discovered by Mr. G. D. Smith in the larva of *Physocnemum brevilineum* Say (Fig. 52).—A. S. P.

Professor Cope's Cave Crustaceans.—Dr. Hagen in the last volume of the Naturalist, p. 494, has called attention to the blind crawfish described by Prof. Cope in the article on Wyandotte Cave in the same volume, p. 406, but no one seems to have noticed the peculiar characters of the other crustaceans described in the same paper. As Prof. Cope's article, with its figures, has been copied in "Nature" and republished without change in the last "Annual Report of the Geological Survey of Indiana," and very likely in other places, it seems quite time these remarkable animals should be noticed.

The "Gammaroid crustacean" from Mammoth Cave (*Stygobromus vitreus* Cope) has a description so uncertain and confused that we wholly fail to comprehend the appellations given to the caudal appendages, without supposing Prof. Cope to have entirely misunderstood their structure and relation in *Niphargus*, and consequently in all gammaroid crustaceans. He speaks of the body in *Niphargus* "terminating in a very long style" and of the "last abdominal limb" as "undivided like that which precedes it." The long style must be *one* of the posterior pair of caudal stylets, and "the last abdominal limb" and "that which precedes it" must refer to the first and second caudal stylets, which are not simple but bi-ramus.

The "unknown crustacean with external egg-pouches," referred to the genus *Cæcidotea*, possesses characters before quite unknown among Isopods. The female is described and figured as a Tetradecapod-like crustacean with egg-sacks, like those of many Entomostraca, attached to the extremity of the abdomen, while in the females of all previously known Tetradecapods, the eggs are carried within lamellæ arising from the bases of the thoracic legs. Its supposed affinities with *Idotea* are still more obscured by the only allusion which is made to the mouth appendages, a figure labelled as "the mandible and palpi of right side," with the explanation that "the outer palpus lies above the lateral plate, and its origin was not seen." Although it is difficult to determine what the appendages referred to really are, it seems to be implied that

the mandible was furnished with a palpus, which is not the case in the family *Idoteidæ* as usually understood. As figured and described, it seems to be a form combining characters distinctive of two primary groups of crustacea, and it is strange Prof. Cope should not have seen in it "the type of a peculiar group of high rank." On account of the interest this little animal must excite, it is to be regretted that it was not more fully described, but it is stated that, "the specimens are in bad condition, having lost their limbs, egg-pouches and the distal portions of their antennæ." This is perhaps the most important sentence in the description. The parasite of the blind fish, a Lernæan, described and figured with egg-sacks similar to those of the species just mentioned, is interesting, not only in itself, but for its possible relations to the *Cæcidotea*. Has not the damaged Isopod been carelessly restored with some of the Lernæan's appendages, instead of having retained them from some Entomostracan progenitor by retardation of development?—S. I. SMITH.

ANTHROPOLOGY.

ANTIQUITY OF MAN IN AMERICA.—In the December number of this journal we made an abstract of a paper printed by the Philadelphia Academy, in which Mr. Berthoud gave an account of the relics of an early race of men. As the geological position of the relics has been questioned, further information is very desirable.

MICROSCOPY.

A DRYING CASE.—Mr. Wm. H. Walmsley has been using for years, in the preparation of his well known microscopical objects, a very convenient and useful drying case. This case is especially useful for hardening balsam mountings, drying tissues, etc. It is made of tin, heated with hot water and well ventilated, capable of drying one hundred specimens at once, and able to retain its heat for eight hours without attention. Microscopists can obtain it from James W. Queen & Co.

AN OBJECT CARRIER.—The object carrier usually furnished with the concentric glass stages is extremely satisfactory for studying mounted specimens, but not equally good for other work. It is unsuitable for a large stage plate, or for a heavy trough or com-

pressor unless moving too stiffly for ordinary use, and unavailable where objects are to be dissected and afterwards drawn with the camera or examined with high powers without risk of losing the object. Hence, for a working instrument, Prof. Biscoe prefers to discard the object carrier altogether and place the slide or other support directly on the stage. This is held in position, if the instrument should be tipped, by a brass sliding bar held by two cranked arms capable of being instantly made to move more or less stiffly by means of screws with milled heads. Should it be desired to place the instrument horizontally, for camera work or photography, an extra piece of brass clamps the object in place.

In Zentmayer's new form of students' microscope the glass sliding stage or object carrier is replaced by a glass sliding-bar, which simplifies the work and reduces the expense as well as secures some of the above advantages.

Some object carriers are arranged, and all should be, except in either mechanical stages or very cheap work, so that the sliding movement can be easily controlled by the pressure of milled-head screws.

NOBERT'S LINES. — Nobert has made for President Barnard a two hundred dollar test plate, twenty-band, which claims to reach 224,000 lines to the inch, being twice as fine as the finest lines on the nineteen-band plate. This puts him far ahead of the opticians, and he claims to be prepared to do still better when they overtake him. Who will make the first lens capable of resolving the twentieth-band? Or will those who believe they are able to resolve diatom-markings of equal fineness show it to us now?

RESOLVING-OBJECTIVES.—The editor of the "Cincinnati Medical News" draws very strongly, not too strongly, the distinction between resolving-objectives and those suitable for other work. He has a Powell & Lealand's one-sixteenth which he finds quite useless except for resolving diatoms. We mainly value, at present, the resolution of the famous tests as showing the achievement of a nicety of correction which can be, and should be, applied to the lower-angled working lenses.

MICROSCOPIC WRITING. — This hitherto rare curiosity is now available to all microscopists, both as an elegant toy and as a useful test for the optical qualities of their lenses. The following account, from a paper read before the Queckett Club, gives a view

of Mr. Wm. Webb's unparalleled success in micro-writing on glass. The specimens thus produced are regarded by Mr. Webb as decidedly the best test-objects; and they may be obtained from Mr. Edmund Wheeler of London.

Mr. Webb says:—"I engrave a series of plates with letters measuring from one two hundred thousandth of an inch to one two hundred millionth of an inch. Each engraving is of the Lord's Prayer, varying only in size, commencing about the thousandth of an inch, which is at the rate of over a quarter of a million letters to the inch, and progressively decreasing the size, the next of the series being at the rate of a million letters to the inch, the next two millions, the next three, and the next four million letters to the inch. Having reached this point, and finding the Old and New Testament together consist of three million five hundred and sixty-six thousand four hundred and eighty letters (for the convenience of a standpoint), I say the lastly enumerated test is at the rate of one Bible to the inch and then engrave the next at the rate of another Bible to the inch, and go on decreasing at the rate of a Bible to the inch down to fifteen Bibles, or, at the rate of fifty-three million four hundred and ninety-seven thousand two hundred letters to the inch; but when it is remembered that the letters are written within two parallel lines, with spaces above and below for long letters, and to enable one line to be distinguishable from another, I most respectfully submit that, such letters as "a," "e," "o," and "u," although averaged, with all other letters, with the capitals, and including spaces, at the fifty-three million four hundred and ninety-seven thousand two hundredth of an inch, being actually written within the lines, after allowing for the extra space occupied by capitals, the spaces between words, and the space between one line of writing and the next line, it may be taken that the "e" actually occupies only one-fourth of the average, or, the two hundred and thirteen million nine hundred and eighty-eight thousand eight hundredth of an inch.

The measurement does not stop at this point, as there are other steps to be traversed—as to one, the dot to an "i," I say nothing now. As to the "e," it is self-evident that it is not a spot of black of the previously estimated less than two hundred millionth of an inch, but composed of a bent and twisted line across, and about the two hundred millionth of an inch; therefore, the thickness of the line has to be considered, and, taking that at a lineal fifth of the space, the two hundred and odd millionth would have to be multiplied by twenty-five as the square of five, which would bring the square of the line down to the five thousand three hundred and forty-nine million seven hundred and twenty thousandth of an inch—and do not stop there, for that five thousand millionth is itself loaded in, and consists of abraded black atoms, grated in by the cutting edge of the glass letter, which atoms can

be seen in different aggregations where the line has not been perfectly filled in, and if at the rate of two atoms of black in the square of the line, the five thousand millionth becomes the ten thousand millionth; if at the rate of twenty atoms of black, the size of the atom is the one hundred thousand millionth of an inch.

I now come to the most important and, to my mind, the most interesting part of the subject, which deals with the tests unblackened. For this purpose I must go back to the square of the line forming the letter as the five billion three hundred and forty-nine million seven hundred and twenty thousandth of an inch that, reduced to its square root, gives seventy-three thousand plus of an inch linear as the breadth of the line.

I mount the same series of slides in the way that Monsieur Nobert mounts his justly celebrated tests — without black—and thus open up a wonderful means of study of the whole subject, helping to afford the power of determining at what breadth unblackened lines become invisible, even when aided by the microscopes of the present day. In this instance the seventy-three thousandth is an absolute line, unbroken by a next line.

When viewing the black lines, ordinary direct illumination is sufficient, but when examining the unblackened lines it becomes necessary to adopt in its turn every available means of illumination, because the cut, being wedge-shaped, each side of the cut, from every part to its very apex, both refracts and reflects again and again the light from the other. Again, the original upper and lower surfaces of the glass refract and reflect the light backwards and forwards; again, the top light flows into the cut, helping to produce the climax which blazes away the cut as the light of the sun overpowers or destroys the light of a candle.

By testing by blackened and by plain unblackened letters, it will be found at what point the power of certain objectives ceases to be effective with transparent objects. I can define the smallest Lord's Prayer when blackened, that is, I can define a line of the seventy-three thousandth of an inch, but have never been able to define the same test unblackened. More than that, although I know the exact spot that it occupies, and mark the spot with an Indian ink ring before it leaves the machine in which it is engraved, I have never (perhaps because of irritable temperament) been able to discover not merely the line, but the aggregation of lines forming the two hundred and twenty-seven letters of the very small tests, although they become perfectly distinct when black."

As a test of distortion, Mr. Webb rules fine black lines upon two pieces of glass, and places one upon the stage and the other upon the diaphragm in the ocular.

Animalcules in Buttermilk.—The "Pacific Medical Journal" believes, with much reason, that the abundance of animalcules dis-

covered in poisonous buttermilk by Dr. J. P. Browne, of Galt, Ontario, were developed in the milk after it had been taken from the cow, instead of being introduced into the cow's system with the food and finding their way through the blood into the milk.

NOTES.

WHEN Professor Agassiz gave his opening lecture in the Museum of Comparative Zoology at Cambridge in 1860, he said that American students had been forced to visit Europe, if they were desirous of making any extended study in the natural sciences, but that he intended to reverse this and compel European students to visit America; and by his judicious purchase of type collections abroad (thanks to the liberality of citizens and our State) he has made his promise good.

Professor Henry A. Ward of Rochester, New York, formerly a student of Professor Agassiz, and since Professor of Geology and Zoology in the Rochester University, has, under humbler auspices, long been working toward the same end. His large cabinet of geology and mineralogy at Rochester is well known to many of our readers. He long ago felt the necessity of bringing before the American student examples of those larger and rarer fossils known to geological science, of which only single specimens existed.

For this purpose he visited Europe, engaged accomplished workmen and commenced the foundation of a collection of casts. With untiring patience and sagacity he secured the moulds of nearly everything of importance, at enormous expense, carrying his workmen from one museum to the other, and taking moulds of the choicest specimens, for a period of three years.

The difficulties encountered in some of his experiences would form an interesting chapter. After many difficulties, he managed to secure moulds of the rare Megatherium, Glyptodon, Deinotherium, Diprotodon, Sivatherium, Colossochelys, Mosasaurus, Plesiosaurus, and many other unique specimens in European museums. Thorough and methodical in all his work, he felt that this collection of casts should be symmetrical and complete, as an educational collection, and so was commenced the famous Ward collection of casts. Thousands of dollars were spent in buying especially choice specimens of the obtainable forms solely for the

purpose of making casts from them, and the originals are still preserved in his museum at Rochester. Every educational institution in the country may now possess perfect casts of the rarest fossils, forming exact facsimiles of the unique originals in the British Museum, the Jardin des Plantes, and other foreign museums, besides a representative collection of all that is needed to illustrate geological history.

From this important beginning, Professor Ward has gone on enlarging the usefulness of his work by adding to his stock, skins and skeletons of animals, fossils and minerals, and alcoholic specimens, so that institutions may provide themselves with collections accurately labelled and arranged, without sending abroad for the purpose.

With the capital invested in so large an enterprise, rapid sales must be effected, and one not familiar with the scientific attainments of Professor Ward, and the sole desire that animates him, to spread far and wide the type collections so important for educational purposes, might confound his occupation with that of the ordinary dealer in natural history objects, such as one may find in any large city. While in the latter case, however, with some laudable exceptions, the dealers offer simply the fortuitous gatherings of sailors, comprising curiosities, shells, and detached portions of animals, like turtles' shields, sharks' jaws, and the like, of no intrinsic value, the work in which Prof. Ward is engaged is one of a solid scientific character. His outlays are immense, yet everything he does is done solely in reference to advancing science. He has the endorsement of every naturalist in the country, and already the leading museums in the country are indebted to him for some of their choicest material.

Every scientific man should visit Professor Ward's place at Rochester, New York, and see the bee-hive of industry he has built up around him. We visited Rochester in February, solely for the purpose of examining the new industry. Here one finds several large buildings, besides sheds and yards devoted to receiving, preparing and shipping specimens. There are twelve men constantly employed as taxidermists, osteologists, moulders and carpenters. Two of the osteologists he has brought from the Jardin des Plantes, Paris, where they had worked for a long time under the direction of eminent anatomists. The skeletons and skulls prepared here are beautiful in their whiteness and the elegance of

their mounting. In the University building is Professor Ward's zoological cabinet, still his private property, containing type forms of the animal kingdom. This is carefully labelled and is strictly an educational collection.

In Cosmos Hall is a large room containing a large and valuable geological collection, particularly rich in Ammonites, fossil cuttle fishes, with the ink glands still preserved; beautiful fossil fishes from the Lias of England and Germany; fine Saurians in slabs; Icthyosaurus, Plesiosaurus, Teleosaurus; also the leg bones and other remains of the remarkable Dinornis from New Zealand; Mastodon and other mammal remains, and an almost perfect skeleton of the rare Glyptodon, the gigantic fossil armadillo.

Great interest attaches to this collection since it contains the original specimens of many of his casts, which have already a traditional value, now that so many institutions possess them. This series of *originals* is of intense interest, and will alone give tone and character to any geological cabinet in which they may be incorporated. In this room may also be seen relief maps and various models of geological import; many of these are familiar to College professors through the descriptions and figures given in Ward's "Illustrated Catalogue." At the time of our visit he was packing a series of casts for the Syracuse University, and a Megatherium was being cast for Dartmouth College. A cast of the skeleton of this latter huge animal may be seen in the Geological Hall of the Smithsonian Institution at Washington, where it was placed by Professor Ward, and copies of it are already in several other museums together with other of his specimens. The series of casts have been invaluable in advancing the study of geology, as their possession is just as important to the instructor in this department, as the possession of the manikin and skeleton is to the successful teaching of human anatomy.

The zoological portion of Professor Ward's establishment most interested us. Here all is on the same large scale. In bringing this collection together, Professor Ward has not only visited various portions of this country and Europe, Asia and Africa, but has his correspondents all over the world, and is constantly receiving from them most varied and rare material. While we were there he had just finished the preparation of a giraffe, thirteen feet in height, and was unpacking boxes containing a moose from Nova Scotia, a caribou from Maine, a bear from Pennsylvania, a huge

basking-shark from the Atlantic coast; and, from Professor Agassiz, a walrus, a small whale, and the rare Rocky Mountain goat, to be mounted for the Cambridge museum.

One building is devoted to taxidermy. The upper room in this building is a wonder to behold; hanging from the ceiling are hundreds of skins, including apes, monkeys, wolves, bears, hyænas, lions, tigers, sloths, ant-eaters, armadillos, buffaloes, deer, elk, moose, giraffe, yak, wild boar, peccaries; besides an immense collection of such animals as kangaroos, Echidna, Wombat, Tasmanian devil, Ornithorynchus, Thylacinus and other rare skins. Some huge alligators, turtles and other reptiles completed the display. In an adjoining room are kept fishes, batrachians, and other specimens in alcohol; among these are Lepidosteus, Amia, Menopoma, Spatularia, Scaphiorynchus, Aspidonectes, and other American species of special anatomical interest. Still another building is devoted exclusively to the preparation of skeletons; these are received with the flesh dried upon them, and are subjected to a long process of maceration and bleaching; over fifty vats are ready to receive them. These vats are all systematically numbered, and the most painstaking care is manifested to secure every bone, so that each specimen may be perfect. Custom work is combined with all this; and hundreds of specimens are received from the museums of Cambridge, Boston, Salem, Philadelphia, Albany, and many of our colleges, for the purpose of being properly prepared and mounted.

We have dealt thus in detail that the public may know the true character of the enterprise in which Professor Ward is engaged; and the duty of every one interested in science and education to cordially sustain him.

Professor Ward has by long study and by travel in foreign countries, as well as by his long experience as a professional teacher of zoology and geology, fitted himself for the important and arduous task before him.

He has received the unqualified endorsement of the leading naturalists, and his untiring devotion to the work, and the immense outlays he has made, should be widely known among those who desire to sustain in this country an institution where one may secure the material for the foundation of a museum, as well as examples for educational purposes.—E. S. MORSE.

[We had the pleasure last summer of visiting Professor Ward's

Rochester Establishment, and of seeing his important collections. One point which Professor Morse has failed to notice is the work done by Mr. Ward in the matter of blocks, labels, shields, and other appliances for the arrangement of cabinets. He has not only planned, but has gone on and constructed the cabinet cases in Vassar, Alleghany and Pittsburg colleges, in the Orange Judd Hall of Science at Wesleyan University in Middletown, Conn., and in the new Syracuse University. At the time of going to press we are informed that Mr. Ward has been engaged to construct the cabinet cases in the new Geological hall—two hundred feet long—of the Smithsonian Institution.—F. W. P.]

It will be seen by the following circular, issued by Professor Agassiz, that a summer school of science for teachers is to be held on Penekese Island, Buzzard's Bay, next summer. From present appearances we may predict every success in its administration. A rare opportunity, such as we believe no country has heretofore afforded, will be offered to those anxious to study the biology, chemistry, and physics, of the sea. Experts will carry on their explorations during three months, and students will thus under the stimulus of their example, be able to learn how to collect, prepare, and study marine animals and plants. If successfully carried out, this school will inaugurate, we believe, a new system of public instruction, and exert the happiest influence on the future progress of science in this country, which depends more than ever on making original investigators. Without further remark we present our readers with a copy of the programme, adding that those who wish to avail themselves of the privileges of the school may address Prof. Agassiz, or the editors of this journal:—

PROGRAMME OF A COURSE OF INSTRUCTION IN NATURAL HISTORY, TO BE DELIVERED BY THE SEASIDE, IN BUZZARD'S BAY, DURING THE SUMMER MONTHS, CHIEFLY DESIGNED FOR TEACHERS WHO PROPOSE TO INTRODUCE THE STUDY INTO THEIR SCHOOLS, AND FOR STUDENTS PREPARING TO BECOME TEACHERS.

Zoölogy in general, and Embryology of the Vertebrates, by Prof. L. AGASSIZ.

The extinct Animals of Past Ages, compared with those now living, and the Methods of identifying them, by Prof. N. S. SHALER.

Comparative Anatomy and Physiology of the Vertebrates, by Prof. B. G. WILDER.

The Animals and Plants living in Deep Waters, and the Peculiar Conditions of their Existence, by L. F. DE POURTALÈS.

Embryology of the Radiates, by A. AGASSIZ.

Natural History and Embryology of the Mollusks, by Prof. E. S. MORSE.

How to make Biological Collections illustrative of the History of Insects injurious to Vegetation, by Prof. H. A. Hagen.

Natural History and Embryology of the Articulates, by Dr. A. S. Packard, Jr.

Natural History of the Fishes and Reptiles, by F. W. Putnam.

Natural History of Birds and Mammals, by J. A. Allen.

On Breeding, and Nests and Eggs of Birds, by Dr. Thomas W. Brewer.

Practical Exercises in the Use of the Microscope, by E. Bicknell.

Instruction in Drawing and Painting of Animals, by Paulus Roetter.

On the Preservation of our Sea-Fisheries, by Prof. Spencer F. Baird.

On Fish Breeding, by Theodore Lyman.

The Faunæ of the North Atlantic, compared with one another and with those of other Parts of the World, by

The Plants of the Sea, by

The Physics of the Sea, by Prof. Joseph Lovering.

Physical Hydrography, by Prof. H. Mitchell.

Chemistry of Feeding and Breathing, by Prof. W. Gibbs.

Chemistry of the Sea and Air, by Prof. James Crafts.

The terms of admission, and the day of opening the course, will be advertised as soon as all the necessary arrangements can be made, including information concerning board, etc. It is hoped that the liberality of friends of education may make it possible to offer this course free of charges to teachers and students. A number of aquariums and the necessary apparatus to dredge in deep water will be provided. The Superintendent of the United States Coast Survey and the United States Commissioner of Fisheries have promised their coöperation to the extent of their ability, without interfering with the regular service of their departments. Professors Shaler, Wilder, Packard, and perhaps others, may spend the whole, or nearly the whole, season at the school, with a view of superintending the laboratory work, while the other gentlemen will stay there only part of the time, or as long as required by the share they are able to take in the course of instruction.

Excursions will be made frequently to give those present an opportunity of learning how to observe, and also of making collections with which they may teach classes at home.

It is but justice to Professor Shaler to say that the first suggestion of giving such a course by the seaside, was made by him.

In behalf of the Faculty of the Museum of
Comparative Zoölogy in Cambridge, Mass.
L. AGASSIZ.

We are happy to announce that Penekese Island, together with the sum of $50,000 to form a permanent endowment of the school, has been generously presented for the purpose by a gentleman in New York interested in science. Buildings will at once be erected, and the school opened early in July. We shall give further par-

ticulars concerning this munificent and most unexpected gift in our next number.

The annual meeting of the California Academy of Sciences was held on Monday evening, January 6, 1873. The following gentlemen were elected officers for the ensuing year:—*President*, George Davidson; *Vice-President*, John Hewston; *Treasurer*, Elisha Brooks; *Corresponding Secretary*, Henry G. Hanks; *Recording Secretary*, C. G. Yale; *Director of the Museum*, H. G. Bloomer; *Librarian*, C. N. Ellinwood, M.D.; *Trustees*, T. P. Madden, D.D. Colton, Robert E. C. Stearns, Oliver Eldridge. The President, Treasurer and Recording Secretary, are also Trustees, *ex-officio*. The President's annual address shows that an increasing interest in the objects of the Academy is manifested by the public, and that the coming year is likely to be one of material interest in the affairs of the Academy.

A regular meeting of the California Academy of Sciences was held Feb. 18, 1873, in which General Hewston announced to the Academy a magnificent donation from James Lick, in the form of a deed to a piece of property on Market street, adjoining the premises of St. Ignatius College on the east. The dimensions of the plot were eighty feet front by two hundred and seventy-five feet in depth, being one hundred vara lot No. 126. The conveyance of the property is subject to various conditions, the purport of which is that the Academy shall erect thereon a substantial three story brick building, faced with granite, in classic style of architecture, and decorated with emblems of science. The building and property shall be devoted exclusively to the purposes of science; it shall remain unencumbered in the possession of the Academy; no part shall be leased at any time, nor shall its use be permitted for political or religious purposes in any way. It further devolves upon the Academy to secure the fund requisite for the erection of the edifice specified within the period of two years, and to prosecute the project to completion within a reasonable time. The plan of the building contemplates among its principal apartments a library, museum and lecture room. The announcement of this donation excited great enthusiasm.

The President remarked that he felt incompetent at the time to express the sense of the Academy in fitting terms. The Trustees, in considering the project of securing accommodations for the

Academy, had never thought of exceeding an expenditure of \$25,000. But this site alone, as he had been assured by competent judges, exceeded in value \$150,000. A meeting of the Trustees will be held to-day, when the body will wait upon Mr. Lick personally, and express the thanks of the Academy for his munificent gift.

As a preliminary expression of gratitude, on motion of Dr. Hewston, the rules of the Academy were suspended, and Mr. Lick was elected a life member.

Professor Davidson read a paper, which embodied the results of laborious research, on the probable periodicity of rainfall, being illustrated with diagrams. He believes in a law of periodicity, but the problem of establishing it was an intricate one, and it had not been developed by the observations of a century. The observations of twenty-one years in California had afforded no direct conclusions.

Dr. Hewston read an exceedingly interesting paper, descriptive of the marine animal, a species of Limnoria, which has recently appeared in the harbor and commenced its ravages on the wharves, threatening the certain and speedy destruction of the whole works of the city front, unless some effective means are adopted for arresting its depredations. Specimens were also submitted to the inspection of the Academy, under the microscope.

Mr. Dall read a paper on the avi-fauna of the Aleutian Islands.

SCIENCE in this state has met a loss in the death of Dr. Henry C. Perkins, of Newburyport, one of the trustees of the Peabody Academy of Science. He devoted much time to microscopical and astronomical studies. One of the leading physicians in this state, he also found time to study science practically. He died very suddenly, February 3d, aged 69.

THE eminent botanist, Professor John Torrey, died March 10th, of pneumonia after a short illness. We can now but refer to the severe loss botanical science in America has suffered from his death.

PROFESSOR SEDGWICK, the celebrated English geologist, died on the 27th of January, aged eighty-seven years. His scientific essays were published mainly in the Transactions of the London Geological Society.

Plate 5.

Loxolophodon cornutus Cope.

1/6 nat. Size.

THE

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THE WINTER STATE OF OUR DUCKWEEDS.

BY PROF. T. D. BISCOÉ.

IN the autumn of 1871, I brought home a bottle full of duckweed (*Lemna polyrrhiza*) and emptied it into a tumbler of water with a mass of algæ gathered at the same time.

Within a few days the Lemnæ all turned white and died, and the fronds seemed to decay. I kept the algæ in the tumbler all winter, adding fresh water as fast as it was diminished by evaporation. I saw no more of the duckweed till the last of the winter, when one day, to my great surprise, there appeared floating on the water a group of fronds that were certainly Lemnæ, and a few days after I noticed another frond. What had they grown from? I turned out the water into a basin and found about fifty little disks which seemed to answer the description of autumnal or winter fronds as described in my "Gray."

My curiosity was excited. How could such things grow into Lemnæ? Where was the growing point? Where were the roots to start from? What was the internal structure of these regular little disks? Should I find anything corresponding to buds about them?

Some of these queries I have answered and others are still unsolved.

I propose to give a short account of my failures and successes, and of the methods of investigation by which I tried to reach the knowledge sought; and hope that my trials may be of service to

some who often desire to make additions to the store of botanical morphology but who hardly know how to proceed.

It is best to select some definite question concerning the case that one wants to study, and then with knife, needles, chemicals and microscope, compel it to yield an answer. It will give definiteness and precision to one's work. I started with this one: "Where is the growing-point of this winter frond?"

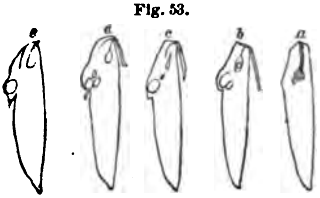
By Figs. 1 and 2, it will be seen that the object is almost exactly of the shape of a shallow plano-convex lens, the flat side being the upper side; as I found some weeks after, when they rose and floated on the surface of the water.

The outline is often slightly kidney-shaped, and at the sinus there is a scar on the edge, Fig. 2*s*. Sections show that the edge is here more obtuse than elsewhere.

Around that point, on the flat surface, there was traced a small semicircle. That was all that could be descried on the exterior. The disk was not at all transparent, so that all knowledge of its interior must be obtained by dissection.

Laying the frond on the end of the forefinger, and holding it in place by a gentle pressure of the thumb, I made three or four slices lengthwise (that is in the direction of the lines *a–a*, *b–b*, etc., of Fig. 2). From the tip three-quarters of the way to the base (as I shall call the scar end) all these sections were composed of simple parenchymous tissue (where cells are of nearly equal dimensions in all directions), whose cells were packed with starch grains. But the quarter next to the base presented very different views in the several sections, and appeared quite complex (Fig. 53). Two regions, Fig. 4 *a* and *b*, attracted attention because of the fineness of the tissue composing them. The cells in these parts were not more than an eighth the diameter of the regular cells of the frond; neither were they filled with starch grains, but were well supplied with protoplasm, with considerable chlorophyl.

Fig. 53.



Here evidently was the place to search for my "growing-point." In that one of these regions furthest from the base, Fig. 4 *a*, and on the convex or under side of the frond, are one, two, or more oval bodies whose axes of growth were nearly at right angles to the length of the frond. I took them for young buds. In each section

one was larger than the rest. I took it for the main bud, and supposed that its extremity was the growing point of the plant. To get a better view of its tip, that I might make out the plan of cell-division at the point where the cells were first formed, I made some new sections in the same direction, much thinner than the first. On examining these I recognized the cell arrangement peculiar to the extremity of roots; there plainly enough was the root-cap, Fig. 4 *d*, and the "summit" cells or region, Fig. 4 *c*, where by cell-division the new growth is produced. These were surely the rudiments of young roots. I must look elsewhere for the plumule with its growing point. But one thing had been learned; my little disk contained roots, and I knew where they were.

The other spot where the cells were small and tinged with green seemed without any regular shape. One section showed one thing, another quite a different thing; while in another there would be nothing but a hole where the fine cells ought to be.

See the differences in the five sections of Fig. 53. These sections were made through the lines marked *a-a*, *b-b*, etc., of Fig. 2.

As the next step I made some sections at right angles to the former in the directions A–A, B–B, etc., of Fig. 2 (see Fig. 5), and got one new idea at least. Instead of there being one body in the place occupied by "*b*," Fig. 4, there were two, one on either side of the median line of the frond, and the two were very unequal in size, though somewhat similar in form. But, although diligently comparing the views presented by the two sets of sections, I could not form any satisfactory idea of these portions. The two sections D and E, of Fig. 5, showed quite clearly the number and position of the young roots. The darker spot which appeared in the last three sections, marked "*s*" in "D," Fig. 5, was a new mystery. I must have sections in the third plane also, that is, the plane passing parallel with the surface of the frond.

And just here let me say a word about making sections of delicate vegetable tissue. I have found it much better in all cases, except where the position and structure of the protoplasm are in question, to soak the specimens in glycerine, first in diluted and finally in strong. One advantage is this; when making sections of soft tissues in water, there is great danger that a thin section on the blade of the razor will dry up and be spoiled, while attending to the piece on one's finger, which ought to be taken off immediately and laid in water. Or if one first cares for the section on the

razor, then the piece from which it is cut may be spoiled. But when the object is in glycerine, plenty of time can be taken to care for both without any injury coming to either. I have found a good razor the very best thing to cut with, much better than any lancet or small dissecting knife.

Let the thumb-nail of the left hand be cut short enough that the blade of the razor may rest against the flesh of the end of the thumb, while the object to be cut rests on the forefinger and is held in place by the thumb. You can then draw the razor very evenly, it being steadied by the thumb. The thickness of the slice can be regulated by pressing the razor less or more against the yielding flesh of the thumb. Especially is this the case when several sections are made one after the other by as many drawings of the razor, each time pressing it a little more against the thumb-end. In this style of cutting, the hand should be so held that the surface of the forefinger, on which the object is laid, should be horizontal; but when a thin object is to be split parallel with its surface, I have found it best to turn the hand, after the object has been placed, as before, between the forefinger and thumb, so that the surface of the finger on which the object is lying should be vertical: you see then the edge of the object to be split. The edge of the razor must, of course, be also a vertical line. It is essential, in this case, that the object be placed far enough back from the ends of the finger and thumb that the razor blade may come between them and be guided and steadied by its contact with them.

Having brought the edge of the razor in contact with the object to be split, draw the razor downward, bringing at the same time the heel outward (towards the right) and the point inward, making the part resting between the thumb and finger the centre of this slight rotation.

During this operation I have found it best so to hold the hands and head that the eye sights right down the edge of the vertically held razor, for then the razor edge can be placed very truly against the exact portion of the object to be split that you desire.

Resuming now our investigation of the duckweed; — I sliced the frond into three or four sections parallel with its surface, and, placing them under the microscope, order seemed to be emerging out of chaos. To the right and left of the middle line of the frond were two cavities, one of them almost filled with one of the small celled bodies, Fig. 6 *rb*, while the other was not more than one-

third filled, Fig. 6 *lb*. The middle line, Fig. 6 *st*, was distinguished from the rest of the frond by the shape of the cells composing it, and also by the fact that they were empty. At one end was the scar, Fig. 6 *sc*, and at the other a snarl of cells out of which radiated five or six veins or ribs, Fig. 6 *v*, consisting of woody fibre with spiral cells; besides, there was a single line of spiral cells turning back into each of the two small-celled bodies. This centre of radiation was what I had seen in the sections of Fig. 5, marked "*s*." This middle portion is the stem of the frond, and the scar marks the place where it separated from its parent frond.

I began then to understand the other appearances; these were the young buds by which Lemna propagates itself independently of seeds. Each one of these would grow into a complete individual, and in it I must look for the "growing-point."

The cavity in which the larger bud grew seemed of a rectangular form, with rounded corners from the lower of which the bud stalk started: the bud itself partook somewhat of the same rectangular shape, instead of being circular, as most of the fronds were.

The young bud on the right, though as yet without any ribs of woody fibre, showed plainly where they were to be, for in the lines that they were to occupy the cells were compact, with no intercellular spaces, while in the rest of the bud between these rudimentary ribs the cells had parted at the corners and produced air spaces, small indeed, but yet sufficient to give a marked character to that portion of the tissue. The part next to the stem of the bud was, like the ribs, without intercellular spaces.

The axes of the frond and buds are at an angle with each other of about 45°, or more correctly 135°, since the normal position of a branch is in nearly the same direction as the stem, and its divergence should be measured round from that direction as its starting point. With our plant the line of growth seems to be backward. If the same law holds in regard to the buds of the next generation then they must be sought near the stem and with their axes inclined at the same angle. (See the diagram, Fig. 9, where the vertical line represents the axis of the frond, and the different oblique lines the axes of the buds.)

A little examination showed that it was so, and that on each side of the axis of the bud, and near the base, was a little protuberance which was evidently a bud of the next generation. But, though they were there, it was by no means so clear what their form might

be, or how far they had advanced in laying the rudiments of the organs possessed by the mature frond. Here began the difficulties of the investigation. My desire was to trace back the frond to the stage in which it was represented by a single cell, or at least by a small group of homogeneous cells, on which there was no sign of any organ; and then to be able to see both where and in what shape. each new part was produced by changes in the growing point and the tissue adjacent thereto.

Of the two budlets, the one on the left, next to the main stem, was the most developed, and I studied it, rather than the other. Figs. 6 and 14 present the views obtained when the razor just grazes the upper surface of the buds. Near the upper edge of the bud was a most delicate line, Fig. 6 *m*, which could hardly be traced with a $\frac{1}{4}$ inch objective. A $\frac{1}{8}$ objective and $\frac{1}{14}$ objective showed that it was the edge of a membrane consisting only of one layer of cells in thickness. The cells, Fig. 55, were irregularly shaped and had crinkled walls. I could follow the line most to the edges of the bud, but not quite. The budlet, Fig. 14, was, like the bud, of a rectangular outline nearly, and grew out from the corner of its cavity. I could make out the following particulars; "*a*" a fine curved line which it took close observation to see at all; "*d*" a double line at the back of the budlet; "*c*" and "*e*" two swellings of the outline of the budlet "*b*;" "*f*" an edge of tissue two cells thick coming to a point where it reached the frond at "*i*;" "*h*" the least developed budlet; and "*g*" a small protuberance of cells, which I have not thoroughly studied and shall therefore be obliged to omit in my descriptions. What it may grow into, if it grow at all, I cannot say.

Horizontal sections had helped greatly, but vertical sections seemed now to offer the only hope of increasing my knowledge of the bud and budlet. After making many, I was no better off, because it was impossible to tell exactly in what direction, as regards the axis of the bud, the sections went. I then split a frond through so as to reveal the upper surface of the bud without touching it with the razor or loosening it from its attachment.

Then with the camera I sketched its outline as seen with a $\frac{1}{4}$ and was then ready for the delicate work of slicing it up. (Fig. 7 gives such an outline.) Taking the frond on the forefinger I cut one section as nearly as possible in the direction which I had decided would give a longitudinal section of the bud, as Fig. 7 *e-e*.

As soon as the cut was made the piece taken off was laid on a slide in a drop of glycerine, and the slide numbered "No 1." Next the frond, from which the cut had been made, was put under the microscope and the direction and position of the cut observed and its place recorded on the camera drawing, and numbered "1." The frond was then laid on the finger and the second cut made, as thin as possible, and as near parallel to the first as might be. I could not succeed in getting the series of cuts as nearly parallel to one another in this way, as by cutting all the sections at once without removing the razor from its rest against the end of my thumb. But generally the deviations from parallelism were not so great as to interfere seriously with the usefulness of the sections, considered as a set.

After each cut, the section was placed on its separate slide and numbered and the remainder of the frond placed under the microscope and the position of the cut marked. In this way I sometimes got a series of fifteen or twenty sections, extending from one edge of the bud to the other. Of these from three to five would pass through the budlet.

Next was the study of these sections one after the other in order, comparing them with each other, and with the surface view of an uncut bud, attempting to construct mentally the complete form of which the microscope gave me successive sectional views. I had had before just as good sections, in some cases better ones, but then could not tell from what part they came and so had been unable to form a connected satisfactory idea, or model, of the whole. One such set shed light in a given direction, but others were needed. Some eight sets of vertical sections in various directions gave all that could be expected of them, and yet the matter was not quite clear. I wanted the budlet sliced in a direction parallel with its surface. The plane of the bud is not quite parallel with that of the frond, so that I could not get just the right sections by the method of splitting the frond between the thumb and forefinger. I could imbed a frond in a mixture of gum and glycerine; but that took so long to harden that, if several fronds were prepared for cutting, I was very apt to forget just where the cut should be made in each, and so run the risk of spoiling the specimen. Something was wanted that would set and harden in a few minutes. I thought of collodion, and on trial it proved to be just what was wanted. When the specimens are saturated with glycerine, and

placed on the end of a little stick of pith, I drop a single drop of collodion over them, which hardens in about two minutes, and without sticking to the specimen makes a complete socket for it. From fronds mounted in this way I succeeded in getting sections so thin that it took three of them to make up the thickness of the budlet.

In order to test the correctness of the opinions formed from the comparison of these different sectional views, I wanted next to dissect out a budlet free from the bud, and in an uninjured state, and turn it over and over while in the field of view of the microscope. I have accustomed myself to the use of dissecting needles under the compound microscope without the help of an erector, and so was able to have the advantage which the binocular gives for such work.

I should advise, from my experience, that any one using a binocular, who has much occasion for dissecting, should learn to handle the needles under the microscope without an erector. It is not difficult to train one hand, though when it comes to using both I acknowledge that one will need a good stock of patience.

The powers used for this work were 80 and 115 diameters. The needles found most useful were those which had been ground with an exceedingly slender taper and the shortest possible piece of the tip bent at an angle of about 45°.

The budlet when obtained free measured about $\frac{3}{1000}$ of an inch in length and half that in breadth and thickness. To observe it to advantage one must use powers of $\frac{1}{4}$ and upwards.

Having placed it in a drop of glycerine, cover with a rather large cover, and let there be enough of the fluid to prevent the cover's pressing it on the slide; then with a needle gently push the cover in one direction or another till you have your object rolling over and over fast or slow just as desired.

Now let us gather up the facts we have obtained by the methods described. Figs. 10, 11, 12, and 13, give specimen sections taken in as many different directions through the bud as shown on the plan, Fig. 7.

The dotted lines in the bud of Fig. 7, show what would be seen when the lower surface of the bud is focussed instead of the upper. I drew them in the same figure in order that their relation to the upper surface might be plainer than if I had given them a separate drawing. In Fig. 10, we have a section passing parallel with the

stem of the bud, but a little to the left. It crosses both the lines in the upper part of the frond, it goes through one of the dotted oval bodies, and also through the budlet to the left of its stem. The section shows that those lines on the upper part of the bud, Fig. 7 *um*, and *lm*, one above and one below, are the edges of two membranes that nearly enclose the bud between them, the one on the upper surface only one layer of cells, the lower several layers thick.

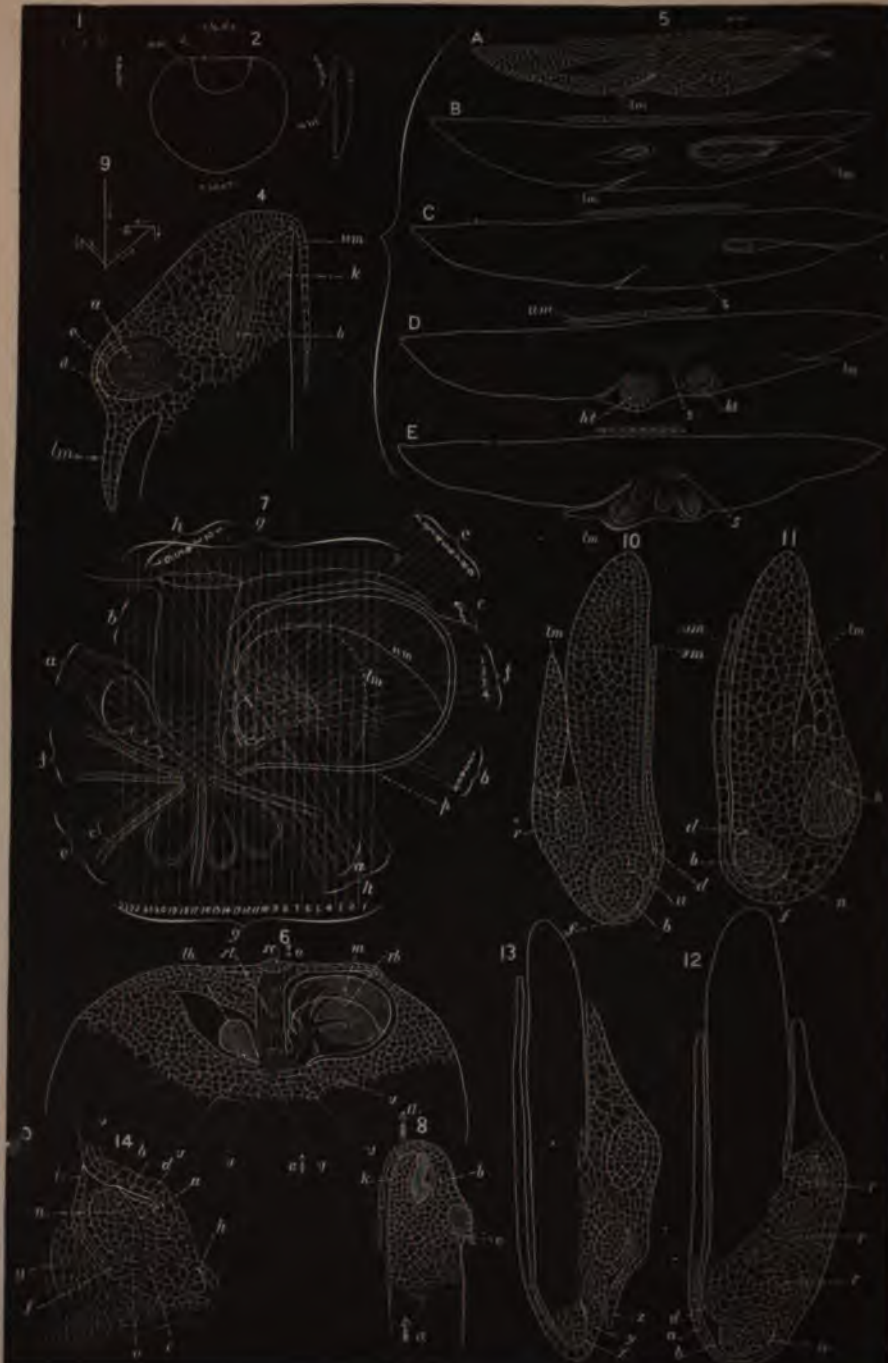
The oval body of Fig. 7 is here seen in the angle between the lower membrane and the body of the bud. It shows itself to be the beginning of a root. The swelling "*d*," Fig. 10, is the section of that projection of the body of the bud over the budlet whose edge shows in Fig. 14 as the double line "*d*." As this projection grows more and more, it shuts over the budlet, reaching down as far as the point "*f*," Fig. 10, and becomes in the frond the lip or cover "*k*," Figs. 4 and 8. The line "*a*," Fig. 14, is shown "*a*," Fig. 10, to be the edge of a ridge starting out from the budlet which as it grows will become the membrane "*um*" of the bud. The section shows us the thickness of the budlet "*b*," and explains that the double row of cells "*f*," Fig. 14, just below the budlet is the optical section of the upper membrane where it bends round to its attachment on the under side of the bud. One cannot help recognizing in the "*um*" of the bud, Fig. 10, the "*um*" of the frond, Fig. 4, which shows itself as the semicircle of Fig. 2.

Turning next to Fig. 11, which also passes through the budlet, but nearer to its stem, and at an angle with the stem of the bud, we find two or three new features. First; we pass through the right hand one of the three oval bodies of Fig. 7, and find it imbedded in the base of the lower membrane, instead of occupying the angle; second, the budlet has a thick horn "*n*" on its under side, and none on its upper. The outline of this membrane is, I think, that indicated by the dotted line, Fig. 14, "*n*," on the budlet, but I have not been able to satisfy myself just where that outline does run. Again, in this section, we see the budlet united with the bud, whereas before, the section, Fig. 10, passed out to the left of the stem and showed that, by lying entirely separate from the bud. Fig. 12, which shows a section nearly parallel with the axis of the budlet, gives a view of both horns "*a*" and "*n*" at once, and showing one root, allows the others r' and r'' to shimmer through the tissue, though out of the focus.

Fig. 13 shows the three roots at once, though with the middle one out of focus. The left hand part of this section is a puzzle to me that I am not sure I have rightly solved. Till I came to it I did not suppose there was any membrane on the lower side like "*z*." In every other section, out of forty, perhaps, that ran through that neighborhood, there was no projection of the lower membrane toward the left, but the tissue passed continuously from the roots round into the base of the upper membrane, as in Figs. 10, 11, 12. I think there may be a narrow lappet or lobe of the lower membrane at just this part, while below the tissue may be as in the other sections. I do not think that the part marked "*x*" is part of the budlet, but of the bud.

Now to take one step more: has the budlet the beginning of a budlet of the next generation? Yes, at the point "*e*," Fig. 14, there is a slight protuberance just about where the upper membrane "*a*," Fig. 14, comes to the edge of the budlet. And this is what will grow into first the budlet, then the bud, and finally the frond.

When the budlet was dissected out and examined with a $\frac{1}{14}$ (Hartnack's No. 10), the protuberance showed nothing but a group of half a dozen to a dozen cells all alike with no sign of any organ of any sort. This then was the growing point which I set out to find. Now how are the different parts of the frond produced from it? As the first stage we have the budlet: it differs from the growing point only in this that a ridge or lappet has been formed on the upper and under surface, which in the sections shows as two horns as "*a*" and "*n*," Fig. 12. These two ridges are really one continuous ridge as I could see when rolling a free budlet over and over. It can be traced from "*e*," Fig. 14, in a slanting curved line to the back of the budlet near its tip, then down the thickness of the budlet till it joins the ridge of the under side. As our next step, we see in the bud our ridge grown into those two membranes (as we have called them) which a careful examination shows to be still continuous at the back edge of the bud about as far out as the point "*p*," Fig. 7. Also three roots, Figs. 7, 10, 11, 12, have made their appearance near and in the base of the lower part of the membrane. Also the tissue of the bud is preparing for the five or six veins that the frond is to possess, and the stem possesses a single fibre of spiral cells. Now, lastly, what more do we find in the frond? The edge "*d*," of Figs. 14 and 10, has grown



ANATOMY OF WINTER BUDS OF LEMNA.

ANATOMY OF WINTER BUDS OF LEMNA.

out over the budlet; and, as the section, Fig. 4, shows, forms the cover " *k* " of the cavity in which the bud " *b*," Fig. 4, lies. The body of the bud, having grown much faster than the membrane, has left the latter as the semicircle seen at the base in Fig. 2. The same thing is true of the lower membrane which now only forms a border to the enlarged roots.

The books speak of Lemna as a plant entirely destitute of leaves, but it seems to me that an exception must be made in the case before us, for this membrane on the upper and under sides

Fig. 54.

Fig. 55.

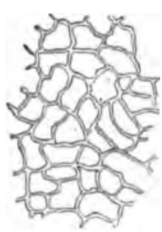
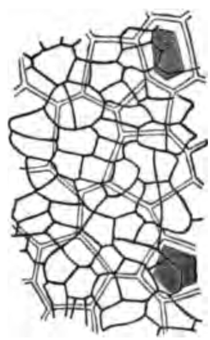


Fig. 56.



seems to answer in its position and formation to the sheathing leaves of the monocotyledons.

I noticed the peculiar form of the cells of the semicircular lobe of the leaf (?) on the upper side of the frond, and made a drawing of them, Fig. 54, and also a drawing of the same organ in the bud state, Fig. 55. It was this peculiar form of cell in the two cases which first led me to think that they were the same thing in different stages of growth. In Fig. 56 I have presented a surface view of the epidermis of the frond, together with the underlying cells of the frond. Two of the latter cells are nearly filled with a large crystal in each. What is the cause of the brown color of some of the cells of the upper lobe of the leaf as shown in Fig. 54, while others are clear, I cannot tell.

EXPLANATION OF PLATE.

Fig. 1. Winter frond, natural size; surface and profile views.

Fig. 2. Same, enlarged about 10 times. The lines, *a-a*, *b-b*, indicate the direction of the sections of Fig. 53, and those marked A-A, B-B, those of Fig. 5; "*s*" is the scar where the frond was attached to its parent; "*um*" the outline of the upper membrane (drawn with 2 inch objective, 2 inch ocular, distance from camera to paper, 5 inches).

Fig. 53. In text, longitudinal vertical sections, as marked in Fig. 2 (objective 2 in., ocular 2 in., distance 5 in.).

Fig. 4. Section in the direction *e-e*, of Fig. 2: "*a*" young root; "*c*" its "summit region;" "*d*" its root-cap; "*b*" young bud; "*k*" lip or cover to the same; "*um*" upper membrane; "*lm*" lower membrane (objective ⅔ in., ocular 2 in., distance 10 in.).

Fig. 5. Sections in the directions A-A, B-B, etc., of Fig. 2: "*s*" of C, D, and E, end of stem; "*rt*" roots; "*lm*" and "*um*" same as Fig. 4 (objective ⅔ in., ocular 2 in., distance 5).

Fig. 6. Horizontal section in the direction of the arrows *a-a* of Fig. 8: "*rb*" the right hand bud or most developed; "*lb*" left hand bud; "*st*" the stem or axis; "*sc*" scar; "*r*" the veins or ribs of the frond; the arrows "*a-a*" show direction of the section of Fig. 8 (objective ⅔, ocular 2, distance 5).

Fig. 7. Outline plan of buds, with lines showing where different sections were made (objective ⅔, ocular 2, distance 10).

Fig. 8. Section through *a-a*, of Fig. 6. "*b*" bud; "*c*" roots. "K" same as *k*, Fig. 4 (objective ⅔, ocular 2, distance 5).

Fig. 9. Diagram of the directions of the axes of growth of the different generations.

Fig. 10. Vertical section of the bud in the position and direction marked by "*e-e*, 5, Fig. 7." "*r*" root; "*f*" base of "*um*;" "*b*" budlet; "*a*" ridge of budlet, or rudiment of the upper membrane; "*d*" rudiment of lip or cover of bud cavity; "*lm*" and "*um*" as before. The lettering and amplification of Figs. 10, 11, 12 and 14, are the same (objective ¼, ocular 2, distance 10).

Fig. 11. Section through "*g-g*, 12, of Fig 7." "*n*" the rudiment of lower membrane.

Fig. 12. Section through "*f-f*, 2 of Fig 7." "*r-r*" "roots below the plane of the rest of the drawing.

Fig. 13. Section through "*b-b*, 5 of Fig. 7." For "*x y z*" see text.

Fig. 14. View of the base of the bud of Fig. 6: "*e*" the growing point or budlet of the next generation; "*h*" corresponds with "*lb*" of Fig. 6; for "*c*" and "*g*" see text.

Fig. 54. In text, surface view of portion of upper membrane of frond (objective ¼ ocular 2, distance 10).

Fig. 55. In text, surface view of the upper membrane of the bud (objective ¼, ocular 2, distance 10).

Fig. 56. In text, epidermis of frond with larger cells of the cellular tissue seen underneath, two of the latter containing crystals (objective ¼, ocular 2, distance 10).

All the drawings are camera lucida work except Fig. 1 and a portion of the cells filling up the sectional views.

THE INFLUENCE OF INSECT-AGENCY ON THE DISTRIBUTION OF PLANTS.

BY F. BUCHANAN WHITE, M.D.

IN urging botanists to study the influence that insect agency has upon the distribution of plants (see vol. x., p. 334), Mr. Bennett

points out a very interesting subject for investigation, and I trust that the readers of the Journal will not lose sight of it.

If *Sphinx Convolvuli* is the chief agent in the fertilization of *Convolvulus sepium*, then the reason why that plant seldom in Britain perfects seed (as is said to be the case) is readily explained. The moth is rare in Britain, and I do not at present remember any record of its having been seen visiting the flowers of *Convolvulus*, though it is generally taken in the act of hovering over flowers, notably *Petunia* and honeysuckle. Though *Sphinx Convolvuli* occurs throughout Britain (even beyond the range of *Convolvulus*, *e.g.* Orkney), yet it is most especially a southern insect, and perhaps that may account *in some measure* for the rarity in a wild state (at least in my experience) of *Convolvulus sepium* in Scotland.

Dianthœcia (a genus of night-flying moths) must exert a great influence upon the fertilization (and consequent abundance) of *Silene* and *Lychnis*. In fact, the perpetuation of the race of these moths depends upon the fertilization of the plants, since the larvæ feed only upon the unripe seeds. This is a case somewhat similar to, though by no means so extraordinary as, that mentioned by Professor Riley at the last meeting of the American Association for the Advancement of Science. Professor Riley showed how the fertilization of *Yucca* depended on the agency of a moth, the female of which collects the pollen and places it on the stigma, for the express purpose that the larvæ, produced from the eggs which she deposits on the ovary of the plant, may have a supply of unripe seeds to feed upon. In regard to *Lychnis* and *Silene*, it is possible that if there were no *Dianthœciæ* the plants might be more numerous, since other moths visit the flowers, though the *Dianthœciæ* are the chief visitors. *Silene maritima* is the most frequented species (it is, perhaps, worth remarking that it has also the largest flowers, and is, perhaps, the most numerous in individuals) of course, in proportion to its restricted usually maritime habitat; *Lychnis Flos-cuculi* is more especially visited by *Dianthœcia Cucubali;* and *Silene Otites* a plant of the eastern counties, by *Dianthœcia irregularis*. On the Continent this insect frequents *Gypsophila paniculata*. I know of no insect visitors to *Silene acaulis* and *Lychnis alpestris*. Possibly, if *Lychnis alpestris* had more insect visitors, it might be more abundant on our mountains, though the peculiarities of the locality (in Forfarshire, at least) have doubtless something to do with its restricted range.

It is probable that insects are the agents in the production of the numerous hybrids that occur between species of the genus Carduus, on the flat horizontal top of whose heads various species of Lepidoptera may often be seen. The downy bodies of these moths would readily convey pollen from one plant to another, and, when the plants were different species, hybridization might be the result in a genus the species of which seem so liable to that phenomenon. *Carduus Carolorum*, which is supposed to be a hybrid between *C. palustris* and *C. heterophyllus*, may have been produced by the agency of *Trichius fasciatus* (a beetle belonging to the family *Cetoniadæ*), whose thorax and underside are very shaggy, and which loves to bury its head and shoulders in the head of a thistle. This beetle is rather rare in Britain, but is not uncommon in the district where *Carduus Carolorum* was found.

The species of *Meligethes* (a genus of small beetles) inhabit flowers. M. Brisout, in *L'Abeille* (vol. viii., January, 1872) points out the flowers in which the various species are generally to be found. Among these are *Genista*, *Galium*, *Prunus spinosa*, *Symphytum officinale*, *Mercurialis perennis*, *Trifolium medium*, *Solanum Dulcamara*, *Melilotus*, *Cyanoglossum officinale*, *Lotus* and other *Leguminosæ*, *Lamium album*, *Galeopsis*, *Mentha*, *Marrubium vulgare*, *Nepeta Cataria*, *Ballota nigra*, *Teucrium Scorodonia*, *Salvia*, and other *Labiatæ*. Many species affect only one kind of plant each, and in going from flower to flower cannot fail to carry pollen with them. *Teucrium Scorodonia* is a great favorite with many nocturnal Lepidoptera, and this, perhaps, partly accounts for the great number of individuals of this plant. Moths usually abound in places where the Teucrium grows.

Many flower-frequenting night moths have more or less strongly developed crests of hairs on the thorax. Many flowers frequented by these moths have blossoms with mouths directed to the horizon (*i. e.* neither drooping nor facing the zenith), and stamens more or less exserted and ascending; styles also more or less exserted. When a moth visits such a flower it either hovers in front of it and plunges its haustellum into the corolla, or else rests on the flower and does the same. In either case it brushes the stamens with its thorax, and carries off unwittingly a supply of pollen to the next flower visited. Now, it is worth noting that some of the moths which hover (*e. g.* the *Plusiidæ* * and *Cucullia*) have very strongly

* Have also crested heads.

developed thoracic crests, and that some flowers which are especially favorites with them have long, exserted, ascending stamens and styles (*e. g. Echium vulgare* and *Lonicera Periclymenum*). If the stamens in these plants were short, the pollen would have little chance of being brushed off by the thorax of the moth, and it does not readily adhere (as the sticky pollen masses of the orchids do) to the haustellum, and if the thorax of the moth were smooth the pollen would not be so liable to be brushed off, even though the stamens are exserted; whereas with exserted and ascending stamens in the flower and crested thorax in the moth, we have every condition necessary to insure a greater or less quantity of pollen being conveyed from one plant to another. In the *Labiatæ* the stamens, though so few, seem to be especially arranged in many species, so that every chance may be afforded of pollen being carried. In *Ajuga reptans* and *Teucrium Scorodonia* the stamens are exserted and ascending, and are four in number — two long and two shorter. An insect therefore in plunging its head into the corolla would almost necessarily brush all the four stamens. These plants are much visited by moths.—*Journal of Botany.*

RELICS OF A HOMESTEAD OF THE STONE AGE.

BY CHARLES C. ABBOTT, M.D.

THE interest that centres in every isolated arrow point or rude stone axe that we chance to come upon, as it is lying in the field — the train of thought that such relics excite in every intelligent observer, absorbing as it is, pales into a commonplace occurrence, when we happen to meet with a series of stone implements of many forms, that epitomize, in their individual and collective characters, the habits, and occupations of their Stone Age owners; and to a far greater extent is this the case, when these collected relics are seen lying in the very spot where their ancient owners left them: the corn-mill and its crushing-stones by the hearth, still black with ashes; the hatchet near by, that was used to split the marrow bones of animals; the polished horn-stone skinning knife, and skin dressers; and back from the fire-place, in separate piles, the battle axe, spears and arrows of each inmate of that household.

In about such positions, each rude relic telling its own story as plainly as ever do the contents of a carefully opened grave, we lately had the good fortune to find a "deposit" of stone implements, numbering in all, about one hundred and seventy specimens.

The discovery of this deposit was made on the removal of the brow or face of a low bluff, and filling up of a shallow valley, that a more level road might be run through the property. A little brook, almost dry in summer, rippled through the valley; which stream was no doubt of much greater volume when the aborigines dwelt upon its banks.

The relics of this "find" were met with in a circumscribed spot of about thirty feet in diameter, and some twenty inches below the surface of the ground. The floor of this "homestead," as we have called it, was very hard and compact; the soil being of a darker color than the superincumbent earth, and well mixed with small oval gravel stones, of a noticeably uniform size. At one side of the nearly circular spot was a well defined fire-place, marked by a circle of oval white stones, six to eight inches in length, and half that in thickness. Within this circle was a layer of ashes and charcoal, seven inches deep in the centre, and three at the margin of the fire-place. This coal and ash deposit showed, on careful examination, a considerable percentage of minute fragments of mussel shell, and of small fragments of bones, too much splintered to identify, but apparently the long bones of wading birds and of the larger fishes.

Of the stone implements, the most noticeable specimen, on account of size, was the large "corn-mill;" a heavy quartzite (?) stone, some fifteen inches in length by ten in width. It was lying in a shallow depression in the floor of the homestead, at the right hand side of the fire-place, and within a foot of the row of white stones that marked that feature of the "find." The mill had but a slight depression on its upper surface, not a quarter of an inch deep, yet clearly traceable on examination, and had evidently been but little used. Lying near it, were two crushing stones, one of which was undoubtedly used in connection with the "mill." It is a flat, nearly circular pebble, about four and one-half inches in diameter. One surface is merely levelled off, by constant rubbing, rather than pecked first and then ground. The opposite side has been pecked over the greater part of its surface, and the centre of the levelled surface has been somewhat hollowed

out, and is smoother than the surrounding merely hammered portion. Associated with the above was a globular quartz pebble, three inches in diameter, that may have been used in connection with the "mill," instead of the crusher we have described; or, in first breaking the hard grains of corn the pebble may have been used, and the flat stone then used to reduce the cracked corn to meal.

Mr. Evans figures (Anc. Stone Impl. G. B. p. 224, fig. 169) a "hammer stone," in size and shape identical with that we have described; and on pages 232–4 describes, under the name of "querns," grain mills, that are in every respect identical, except that as a class they may be larger and more elaborate in finish.

Near the mill and its accompanying stones, just described, we found four "net-weights" as they are usually called. One was a globular pebble, with a shallow depression about it, that was roughly and very irregularly pecked. Another was a flattened pebble, with a notch well defined at each side; being of the more abundant form of "sinkers," but much thicker than the other two specimens, and than the notched weights generally are. One of the two thin, flat specimens was of more interest than these specimens usually are, in that there were three well defined notches. It is not easy to determine the use of this third notch.

Near the sinkers were five rudely chipped implements (?) or more probably failures. While exhibiting abundant traces of having been worked by man, it is doubtful if they were ever put to any use. Their general appearance was not that of cores, either, from which flakes had been struck; nor was there any trace of chipping having been carried on within the limits of the homestead we are now describing. A very rude implement is frequently found in this neighborhood, but on it a cutting edge is always a noticeable feature; but in these there was nothing that could be called a cutting edge, except at one part of the larger of the five specimens.

On referring to illustrations of "drift" implements in Mr. Evans' work above quoted, and to "Reliquiæ Aquitanicæ," we find many so-called implements fully as rude as the least finished of the five above mentioned. What gives to these a peculiar interest, however, is not their similarity to the "drift implements" of Europe, but their association with some of the very finest wrought stone implements and arrowheads. It is a puzzle to know what the fash-

ioners of these latter could want, or do, with what, at best, are merely broken stones.

There were also three well marked hammer stones of the common pattern. Flat, oval pebbles, well battered at the ends, and side depressions for the thumb and second finger, the forefinger being curled over the hammering end *not in use;* as both extremities show that they have been each well used. These hammer stones are identical in form with those found in Great Britain, as will be seen on reference to Mr. Evans' work, pages 214–20.

There was also found with these hammers, half of a very pretty hone, which long usage has worn down to very smooth surfaces. The specimen, if broken in halves, has been about five inches long, and is one and one-quarter inches in length, by scant half an inch in thickness. The two sides are both perfectly level to within a short distance of the edge, when they slope off at a slight angle.

Hones of this character, and others with curved sharpening or polishing surfaces, are met with on the surface, where the commoner forms of relics are found, but they are not abundant.

There were also two cylindrical stones, of a pestle-like appearance, that were, of course, brought by the former occupants of this camp or homestead, to the enclosure we are describing, but whether used as pestles or selected for polishing stones, but never used, it is very hard to decide; and with these may be mentioned a curiously worn pebble that has much the appearance of having been commenced for a polished skinning knife, and never completed. As the superincumbent earth was purely a vegetable mould, and contained no pebbles, it is not likely that either this or the "pestles" got within the "find," and became associated with the unquestionable relics, by mere accident.

One naturally expects to find those chipped flints that are universally known as "scrapers," in every considerable "find" of stone implements; nor were they here wanting; two specimens of unquestionable scrapers being found, and an allied form of chipped jasper, that seems to be a connecting link, as it were, between scrapers and lance-heads; the specimen has the appearance of having been commenced for a spear and, injured for that purpose by an unlucky blow, subsequently chipped into its present shape and made to answer as a scraper.

The two genuine scrapers that were found, are of unusual interest, in being strictly of the European form, and not in any way

similar to the elaborately chipped jaspers, that are so abundant on the surface, and which are believed also to have been scrapers.

The two scrapers found measure about three inches in length, by one and three-quarters in breadth. They are irregularly oval, with the under surface, in each case, being nearly the plane of a single cleavage. They are both chipped from the same block or core of stone, a bluish grey jasper, of which many of the finest arrowheads were made.

The larger of the two scrapers bears a remarkable resemblance to a Bridlington scraper, figured in Mr. Evans' work, page 276, fig. 218; but is about double the size.

An implement was found near the scrapers, that we will next refer to, before noticing the weapons proper; the specimen being a finely polished skinning knife, of more than ordinary beauty of finish. This fine "celt," as it would be called in England, measures but three inches and one-quarter in length, and has a cutting edge a trace over an inch in extent. The surface generally is polished; but most care has been taken with the cutting qualities of the instrument, and the edge and sides adjoining it have received a polish that we have never seen excelled in any stone implement. The material looks like a conglomerate of quartz and agate.

The only other domestic implement was a rough gouge, made of serpentine and with the edge well preserved. The specimen measures seven inches in length; the edge and a distance therefrom of about one and one-half inches is entire and this portion is quite well polished, while the remainder apparently never has been. The edge, which is very slightly curved, measures one and one-half inches in width; the corners of the blade being protected by a narrow ridge, which gradually widens as it recedes from the cutting edge.

Nothing further of a domestic nature was found, or indeed, was present on the spot; for most thorough search was made, under very favorable circumstances; but opposite the fire-place, in what appeared to have been three separate heaps which were unfortunately mixed together in uncovering them, was a fine series of arrow and spear points, and one or two chipped jasper specimens, similar to, but not unquestionably lanceheads.

The arrowheads being the most prominent portion of this part of the "find," we will first give a hurried enumeration of their numbers and types. Mineralogically, this lot of arrowheads was

interesting, in showing a good deal more than usual variation in the materials used. The minerals being quartz, purple, yellow, and brown jasper, hornstone, slate, sandstone, and a peculiar conglomerate containing mica, not often met with in the shape of relics.

Considered in the matter of types, we found there were sixteen stemmed arrowpoints, of large size, excellent workmanship, and all of jasper, of the various colors in which this mineral occurs. Six of these specimens were barbed and stemmed, the others had simply a projecting tang. Four were flat, thin and sharply edged; the others mostly with a median ridge.

There was also a pretty, triangular arrowpoint, two and one-half inches long, and one and one-half inches wide at the base; and a quartz point that was pentagonal, approaching thus the leaf-shaped form, which was noticeably absent in this find.

The white quartz arrowpoints numbered forty-four specimens, and as a rule were small, and of less finish than specimens of this mineral are apt to be. Twenty-nine were stemmed; five were of the "lozenge" pattern, and ten were triangular specimens, these latter all having the concave base. Of the stemmed specimens only three had "notched bases."

Of what might be called common specimens, there were forty-eight that could be separated into six types, as follows: seven were lozenge-shaped points, and excellent examples of this form; ten were triangular points, four with concave bases, five with straight bases, and one with a convex base, being *almost* a leaf-shaped specimen; two were true leaf-shaped points; and one of this pattern, but stemmed also, being a form not often met with; ten were excellent *barbed* arrowpoints, that is, with the corners of the blade sharply pointed and making the base of the blade much wider than the stem; eleven specimens were of the "notched base" pattern, *i. e.* with a stem about as wide as the blade, and separated from it only by a semicircular notch or indentation; seven were plain stemmed points, a form that is not readily distinguished from the lozenge shape, as we recognize that pattern among the specimens gathered by us. Indeed, the plain stemmed arrowpoint graduates readily into the true leaf-shaped form.

Of spearheads there were but five specimens; two short stemmed examples, made of slate, and in no way noticeable. A third was of slate also, but much more carefully wrought, and a beautiful example of the "notched base" pattern. It measured four

inches, lacking an eighth, and was noticeable particularly for the median ridge running its whole length and from this ridge the specimen was very regularly bevelled to the sides. The notches at the base were large and deep, and the stem narrower than the base of the blade. The fourth example of the spearheads was like the preceding but about one third shorter. The remaining spearhead was more interesting, in that it nearly approached the true leaf-shaped pattern; a blunt barb-like widening at the base making it vary from that form a little, the stem or base itself being rounded.

Before noticing the collection of knives, as we propose calling a series of implements contained in this "find," we will briefly allude to three other specimens, that seem different in some respects from any of the above. One is a roughly chipped implement of agate, three inches in length, and a trace over two in greatest width. The base is blunt, being the natural surface of the pebble from which the specimen was chipped; the edges, although crooked, are sharp, and the point well defined and still acute. The specimen itself suggests a small lancehead, an unfinished knife, or a small hatchet, that might have been used to split long bones, that the marrow might be secured. It is much less finished and finely flaked than the jasper lanceheads we have so frequently met with on the surface and in graves. The second of these three specimens is a beautifully chipped jasper specimen, that appears to have been a long stemmed spear, which, being broken near the base, has had the fractured end carefully rechipped. As the specimen now is, it is a triangular "flint," two and five-eighths inches long, and one and one-half inches wide. It may be looked upon as a knife made from a spear, we suppose; inasmuch as so many, approaching it in character, were found at the same time. The third specimen is a rudely chipped oval knife (?) blade, noticeable as having been made of white quartz; a mineral not often used except for arrow-heads.

We have now to consider a remarkable series of hornstone implements, forty-two in number, which have much of interest connected with them. As a class, they may be said to approach the flint dagger blades figured by Mr. Evans, on page 315 of his work on the Stone Implements of Great Britain. They can be described as "chipped flints," with square bases, well defined points, and slightly convex sides, averaging three and one-half inches in length by one inch in breadth. Six of them have convex

bases, and consequently are leaf-shaped arrowpoints of a large size. In no one specimen is there any distinct notching of the sides, near the base, to facilitate the fastening of a handle; and for this reason we have thought that they may have been knives, rather than spearpoints or arrowpoints; but it is possible that they were intended as war arrowheads, and were to be only slightly inserted in the shaft; so that the person shot could not dislodge the stone point, by drawing the shaft from the wound. It seems almost useless to conjecture as to the particular use of these or indeed any specimens, which, from their shape and size, show that they may have been used for several different purposes.

A fact, fully as interesting as the presence of any or all of these relics, consists in the absence of two common forms of "Indian relics," namely: the ordinary grooved cobble-stone axe, and fragments of pottery; no specimen of the former or trace of the latter could be found anywhere about the limits of the beaten discolored ground that we have called a homestead.

Now arises the question, whence came the people who once occupied this spot, and left these abundant traces of their sojourn here? Marking the degree of civilization, or rather, of its absence, as estimated by these relics, does it, indeed, seem possible, as sketched by Haeckel,* that from hypothetical Lemuria, in the Indian ocean, a being worthy *then* to be called a man, could finally, after many ages, reach North-west America, and then cross our broad continent, to reach the Atlantic coast, in a state of advancement only equal to the production of such rude stone implements as we have described? We do not doubt the correctness of the theory of the evolution of man from creatures not men, but that the ancestors of the American red-skin lived nearer home than the Indian ocean, we cannot but think; and we fail, as yet to see, *how* "the dispute between the monogenists and the polygenists can die a silent and unobserved death;"† unless indeed it be by the final victory of the polygenetic school.

* Reproduced by Chapman in "Evolution of Life," p. 177.
† Descent of Man, vol. 1. p. 235. English edition.

THE GEYSERS OF MONTANA.

THE first detailed account we have of these wonders of geology was published by Mr. N. P. Langford, who was one of an exploring party under General Washburn, sent out in the summer of 1870. His article was published in "Scribner's Monthly," while the official report to Congress was written by Lieutenant Doane, U. S. A. From Professor F. V. Hayden's interesting and valuable report for 1871 we take the following still more extended account of these geysers, and are indebted to him for the use of the accompanying illustrations.

The geyser basin of Fire Hole river is near Yellowstone lake, the source of the Yellowstone river, of the wonders of which we give some account elsewhere in this number.

In the course of their wanderings in search of the Fire Hole basin the party under Prof. Hayden fortunately struck the sources of the East Fork of the Madison instead of those of the Fire Hole, and thus were enabled to see many fine springs which would otherwise have escaped attention, and there is no doubt, says Prof. Hayden, that subsequent explorations about the sources of the Yellowstone, Missouri and Snake rivers, will reveal many other groups of hot springs and geysers.

The entire valley of the East Fork, from its source to its junction with the Madison, extending over an area twenty-five miles long, and an average of half a mile in width, is covered with the silicious deposits of the hot springs, ancient and modern. The bed of the stream is lined with white silica, and the valley itself looks like an alkali flat. One group of thirty or forty springs is noticed, and the springs of the Lower Geyser basin are described and mapped. The main basin, the most beautiful of all in this last group, was ten by fifteen feet, the water 128°, marvellously transparent and of a most delicate blue; as the surface is stirred by the passing breeze, all the colors of the prism are shewn, literally a series of rainbows. He calls the most delicately colored springs Prismatic springs.

Entering the Fire Hole basin, the party visited one of the most remarkable mud-pots in the valley (Fig. 57). "The diameter

Fig. 57.

Mud Puff, Lower Fire-hole.

within the rim is forty by sixty feet, and forms a vast mortar bed of the finest material. The surface is covered with large puffs, and as each one bursts, the mud spurts upwards several feet with a suppressed thud. The mud is an impalpable, silicious clay, fine enough, it would seem, for the manufacture of the choicest ware. The colors are of every shade, from the purest white to a bright rich pink. The surface is covered with twenty or thirty of these puffs, which are bursting each second, tossing the mud in every direction on to the broad rounded rim. There are several other mud puffs in the vicinity, but they do not differ materially from the last, except in size."

We now come to the genuine geysers. Fig. 58 gives a view of one of the elevated craters called the Bee Hive; another much

Fig. 58.

The Bee-hive.

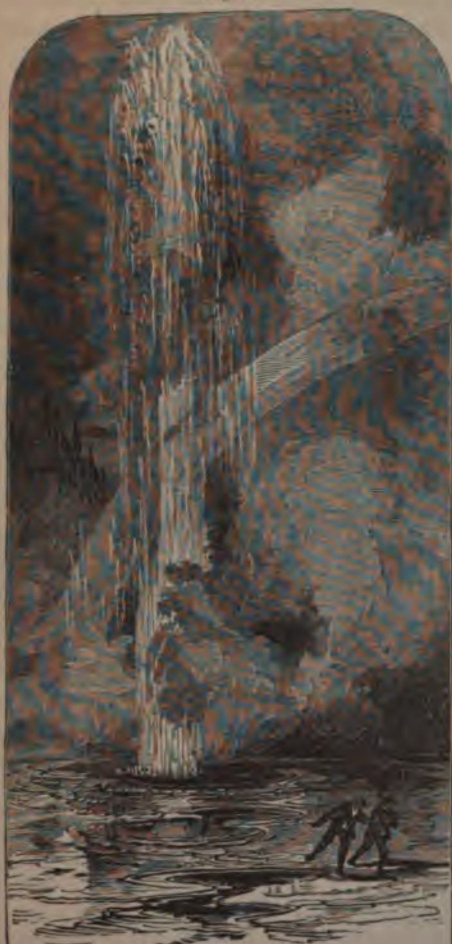
larger is styled the White Dome. "The broad mound is fifteen feet high, and upon this is a chimney about twenty feet in height. The steam issues steadily from the top like a high pressure engine."

We copy Prof. Hayden's description of this wonderful valley:—

"Early in the morning of August 30, the valley was literally filled with columns of steam, ascending from more than a thousand vents. I can compare the view to nothing but that of some manufacturing city like Pittsburgh, as seen from a high point, except that instead of the black coal smoke, there are here the white delicate clouds of steam. Small groups or solitary springs that are scattered everywhere in the woods, upon the mountain-sides, and which would otherwise have escaped observation, are detected by the columns of steam. It is evident that some of these groups of

springs have changed their base of operations within a comparatively recent period; for about midway on the east side of the lower basin there is a large area covered with a thick, apparently modern, deposit of the silica, as white as snow, while standing quite thickly all around are the dead pines, which appear to have been destroyed by the excessive overflow of the water and the increased deposition. These dry trees have a most desolate look; many of them have fallen down and are incrusted with the silica, while portions that have fallen into the boiling springs have been reduced to a pulp. This seems to be one of the conditions of silicification, for when these pulpy masses of wood are permitted to dry by the cessation of the springs, the most perfect specimens of petrified wood are the result. In one instance a green pine-tree had fallen so as to immerse its thick top in a large hot basin, and leaves, twigs and cones had become completely incrusted with the white silica, and a portion had entered into the cellular structure, so that when removed from the water, and dried in the sun, very fair specimens were obtained."

Fig. 59.



Grand Geyser.

The Upper Geyser basin contains the most remarkable geysers, of which the first one is the Grand Geyser (Fig. 59). Says Hayden:—

"Soon after reaching camp a tremendous rumbling was heard,

shaking the ground in every direction, and soon a column of steam burst forth from a crater near the edge of the east side of the river. Following the steam, arose by a succession of impulses, a column of water, apparently 6 feet in diameter, to the height of 200 feet, while the steam ascended a thousand feet or more. It would be difficult to describe the intense excitement which attended such a display. It is probable that if we could have remained in the

Fig. 60.

Grand Geyser, Upper Geyser Basin, Fire-hole River.

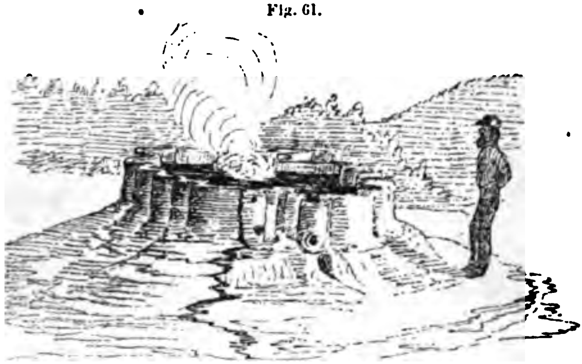
valley several days, and become accustomed to all the preliminary warnings, the excitement would have ceased, and we could have admired calmly the marvellous ease and beauty with which this column of hot water was held up to that great height for the space of twenty minutes. After the display is over the water settles down in the basin several inches, and the temperature slowly falls to 150°. We called this the Grand Geyser, for its power seemed

greater than any other of which we obtained any knowledge in the valley. (Fig. 59.) There are two orifices in one basin; one of them seems to have no raised rim, and is a very modest-looking spring in a state of quiescence, and no one would for a moment suspect the power that was temporarily slumbering below. The orifice is oblong, 2½ by 4 feet, while for the space of 10 feet in every direction around it are rounded masses of silica, from a few inches to 3 feet in diameter, looking like spongiform corals. Nothing could exceed the crystal clearness of the water."

Fig. 60 gives a view of another eruption of the same geyser.

As an example of exhausted geysers may be cited the Punch Bowl (Fig. 61), which is a low crater or chimney in which the

Fig. 61.



Punch Bowl.

water boils two or three feet high only. A large example of a rugged crater is the Giant (Fig. 62), which says Mr. Langford, in "Scribner's Monthly" "has a rugged crater, ten feet in diameter on the outside, with an irregular orifice five or six feet in diameter. It discharges a vast body of water, and the only time we saw it in eruption the flow of water in a column five feet in diameter, and one hundred and forty feet in vertical height, continued uninterruptedly for nearly three hours. The crater resembles a miniature model of the Coliseum."

The "Giantess," however, honored the party with a grand eruption, an account of which we give in Prof. Hayden's own words: —

"Our search for new wonders leading us across the Fire-Hole river, we ascended a gentle incrusted slope, and came suddenly upon a large oval aperture with scalloped edges, the diameters of which were 18 and 25 feet, the sides corrugated and covered with

a grayish-white silicious deposit, which was distinctly visible at the depth of 100 feet below the surface. No water could be discovered, but we could distinctly hear it gurgling and boiling at a great distance below. Suddenly it began to rise, boiling and spluttering, and sending out huge masses of steam, causing a general stampede of our company, driving us some distance from our point of observation. When within about 40 feet of the surface, it became stationary, and we returned to look down upon it. It was foaming and surging at a terrible rate, occasionally emitting small jets of hot water nearly to the mouth of the orifice. All at once it seemed seized with a fearful spasm, and rose with incredible rapidity, hardly affording us time to flee to a safe distance, when it burst from the orifice with terrific momentum, rising in a column

Fig. 62.

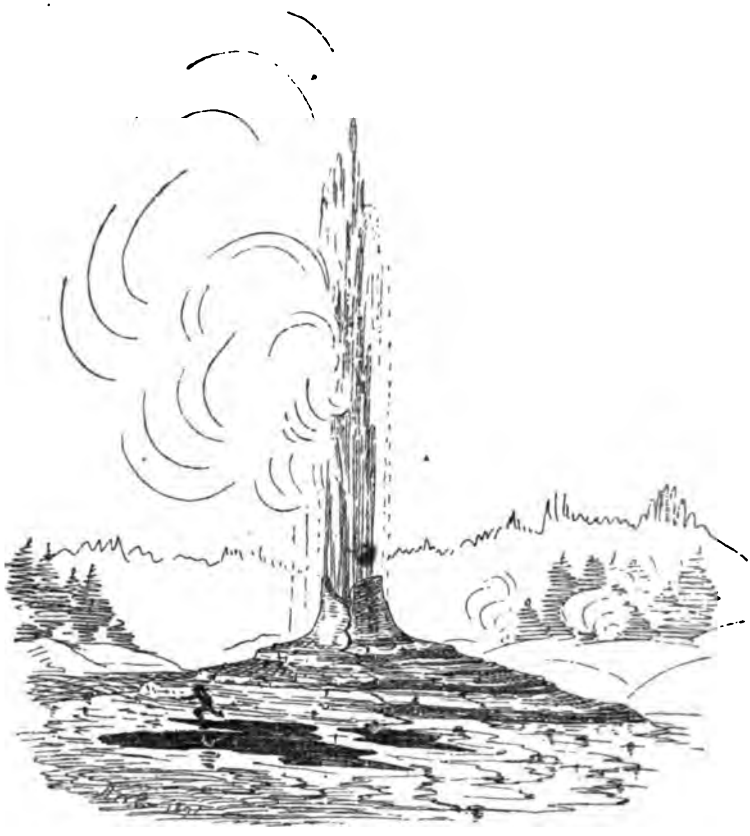
The Giant.

the full size of this immense aperture to the height of 60 feet; and through and out of the apex of this vast aqueous mass, five or six lesser jets or round columns of water, varying in size from 6 to 15 inches in diameter, were projected to the marvellous height of 250 feet. These lesser jets, so much higher than the main column, and shooting through it, doubtless proceed from auxiliary pipes leading into the principal orifice near the bottom, where the explosive force is greater. If the theory that water by constant boiling becomes explosive when freed from air be true, this theory rationally accounts for all irregularities in the eruptions of the geysers.

This grand eruption continued for twenty minutes, and was the most magnificent sight we ever witnessed. We were standing

on the side of the geysers nearest the sun, the gleams of which filled the sparkling column of water and spray with myriads of rainbows, whose arches were constantly changing — dipping and fluttering hither and thither, and disappearing only to be succeeded by others, again and again, amid the aqueous column, while the minute globules into which the spent jets were diffused when falling

Fig. 63.



Old Faithful, Upper Geyser Basin, Fire-hole River.

sparkled like a shower of diamonds, and around every shadow which the denser clouds of vapor, interrupting the sun's rays, cast upon the column, could be seen a luminous circle radiant with all the colors of the prism, and resembling the halo of glory represented in paintings as encircling the head of Divinity. All that we had previously witnessed seemed tame in comparison with the perfect grandeur and beauty of this display. Two of these wonder-

ful eruptions occurred during the twenty-two hours we remained in the valley. This geyser we named "The Giantess."

Another fine geyser is "Old Faithful" (Fig. 63), as it was christened by Messrs. Langford and Doane. It shoots up a column of water about six feet in diameter to the height of 100 to 150 feet, "and by a succession of impulses seemed to hold it up steadily for the space of fifteen minutes, the great mass of water falling directly back into the basin, and flowing over the edges and down the sides in large streams. When the action ceases, the water recedes beyond sight, and nothing is heard but the occasional escape of steam until another exhibition occurs."

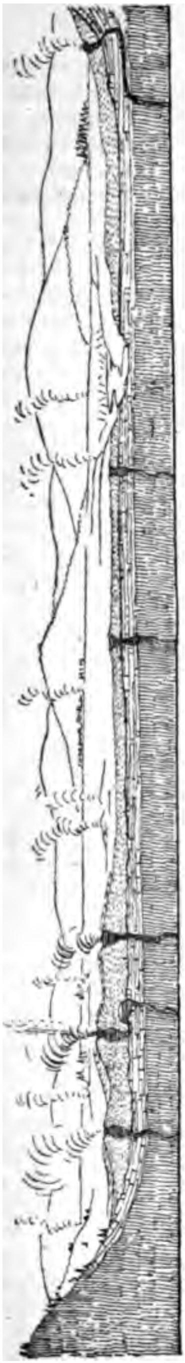


Fig. 64.

Ideal Section, Upper Geyser Basin, Fire-hole River.

Fig. 64 is an ideal section of a portion of the Upper Geyser Valley sketched by Mr. Elliott for the purpose of conveying a "clearer conception of the way in which we may suppose the waters of many of the springs reach the surface. The lower portion of the section is basalt, then lake or local drift deposits, and thirdly the crust of silica, which forms a floor of greater or less thickness for the entire valley."

It is evident that the geysers of Iceland are tame in comparison with those of Montana, while the latter are similar to those of New Zealand. Concerning the origin of geysers, Hayden quotes as follows from Hochstetter's "New Zealand:"

"Both kinds of springs owe their origin to the water permeating the surface and sinking through fissures into the bowels of the earth, where it becomes heated by the still existing volcanic fires. High-pressure steam is thus generated, which, accompanied by volcanic gases, such as muriatic acid, sulphurous acid, sulphuretted hydrogen, and carbonic acid, rises

again toward the colder surface, and is there condensed into hot water. The over-heated steam, however, and the gases decompose the rock beneath, dissolve certain ingredients, and deposit them on the surface. According to Bunsen's ingenious observations, a chronological succession takes place in the coöperation of the gases. The sulphurous acid acts first. It must be generated there where rising sulphur vapor comes into contact with glowing masses of rock. Wherever vapors of sulphurous acid are constantly formed, there acid springs, or solfataras, arise. Incrustations of alum are very common in such places, arising from the action of sulphuric acid on the alumina and alkali of the lavas; another product of the decomposition of the lavas is gypsum, or sulphate of lime, the residuum being a more or less ferruginous fumarole clay, the material of the mudpools. To the sulphurous acid comes sulphuretted hydrogen, produced by the action of steam upon sulphides, and by the mutual decomposition of the sulphuretted hydrogen and sulphurous acid, sulphur is formed, which in all solfataras forms the characteristic precipitate, while the decomposition of silicious incrustations is either entirely wanting or quite inconsiderable, and a smell of sulphuretted hydrogen is but rarely noticed. These acid springs have no periodical outbursts of water.

In course of time, however, the source of sulphurous acid becomes exhausted, and sulphuretted hydrogen alone remains active. The acid reaction of the soil disappears, yielding to an alkaline reaction by the formation of sulphides. At the same time the action of carbonic acid begins upon the rocks, and the alkaline bicarbonates thus produced dissolve the silica, which, on the evaporation of the water, deposits in the form of opal, or quartz, or silicious earth, and thus the shell of the springs is formed, upon the structure of which the periodicity of the outbursts depends. Professor Bunsen, rejecting the antiquated theory of Makenzie, based upon the existence of subterraneous chambers, from which the water, from time to time, is pressed up through the vapors accumulating on its surface, according to the principle of the Hern fountain, has proved in the case of the great geyser that the periodical eruptions or explosions essentially depend upon the existence of a frame of silicious deposits, with a deep, flue-shaped tube, and upon the sudden development of larger masses of steam from the overheated water in the lower portions of the tube. The deposition of silica in quantities sufficient for the formation of this spring apparatus in the course of years takes place only in the alkaline springs. Their water is either entirely neutral or has a slightly alkaline reaction. Silica, chloride of sodium, carbonates, and sulphates are the chief ingredients dissolved in it. In the place of sulphurous acid the odor of sulphuretted hydrogen is sometimes observed in these springs.

The rocks, from which the silicious hot-springs of New Zealand derive their silica, are rhyolites, and rhyolithic tufas, containing seventy and more per cent. of silica; while we know that in

Iceland palagonite, and palagonitic tufas, with fifty per cent. of silica, are considered as the material acted upon and lixiviated by the hot water. By the gradual cooling of the volcanic rocks under the surface of the earth in the course of centuries the hot springs also will gradually disappear; for they too are but a transient phenomenon in the eternal change of everything created." — (Hochstetter's "New Zealand," English translation, p. 432.)

Bischof in his "Researches into the internal heat of the globe," thus discourses on the origin of the Geysers of Iceland: —

"No doubt can be entertained respecting the nature of the agent by which the waters of the geyser, the Strokr, and other less considerable springs, are thrown to such an immense height. It is, as in volcanoes, a gaseous body, principally aqueous vapor. We may, therefore, very fairly agree with Krug Von Nidda, and consider volcanoes in the same light as intermittent springs, with this difference only, that instead of water, they throw out melted matters.

"He takes it for granted that these hot springs derive their temperature from aqueous vapors rising from below. When these vapors are able to rise freely in a continual column, the water at the different depths must have a constant temperature, equal to that at which water would boil under the pressure existing at the respective depths; hence the constant ebullition of the permanent springs and their boiling heat. If, on the other hand, the vapors be prevented by the complicated windings of its channels from rising to the surface; if, for example, they be arrested in caverns, the temperature in the upper layers of water must necessarily become reduced, because a large quantity of it is lost by evaporation at the surface, which cannot be replaced from below. And any circulation of the layers of water at different temperatures, by reason of their unequal specific gravities, seems to be very much interrupted by the narrowness and sinuosity of the passage. The intermitting springs of Iceland are probably caused by the existence of caverns, in which the vapor is retained by the pressure of the column of water in the channel which leads to the surface. Here this vapor collects, and presses the water in the cavern downward until its elastic force becomes sufficiently great to effect a passage through the column of water which confines it. The violent escape of the vapor causes the thunder-like subterranean sound and the trembling of the earth which precedes each eruption. The vapors do not appear at the surface till they have heated the water to their own temperature. When so much vapor has escaped that the expansive force of that which remains has become less than the pressure of the confining column of water, tranquillity is restored, and this lasts until such a quantity of vapor is again collected as to produce a fresh eruption. The spouting of the spring is therefore repeated at intervals, depending upon the capacity of

the cavern, the height of the column of water, and the heat generated below."

With this work and the admirable series of photographs by Mr. Jackson (both in sheets* and stereoscopic form, published by Prof. Hayden) of some of the finest views in the National Yellowstone Park and Colorado Territory, the reader can obtain a very clear idea of the Geyser region, of the springs in course of eruption, and of the falls and basin of the Yellowstone. We see by the papers that it is proposed to open roads into the National Park, and erect hotels at the Geysers for the convenience of the public.

ON SOME OF PROF. MARSH'S CRITICISMS.

BY E. D. COPE.

I.

I have already (in "The short-footed Ungulata of the Eocene of Wyoming;" Naturalists' Agency, Salem, Mass.) shown, by figures and descriptions, the absence of foundation for Professor Marsh's recent animadversions, and though these latter present internal evidence of idiosyncracy which almost disarms reply, yet as some of the readers of this journal may not see the above essay, I make a few specific contradictions of some of his statements which may be regarded as serious.

In an article "On the Gigantic Fossil Mammals of the Order Dinocerata," he writes as follows:

"(1) What Prof. Cope has called incisors are canines, etc." I had determined and stated them to be canines, in the American Naturalist, previous to the appearance of this criticism.

"(2) The stout horns he described are not on the frontals but on the maxillaries." I was the first to determine these bones to be nasals, and find that in *Eobasileus* they compose the inner face of the horns to the apex, while the maxillaries form the outer face.†

* Sun Pictures of Rocky Mountain Scenery. By F. V. Hayden. The Rocky Mountain Album. By F. V. Hayden and A. H. Jackson, Photographer.

† (See my paper, p. 18). Professor Marsh has since contradicted the former statement flatly.

"(3) The orbit is not below these horns but quite behind them, and has over it a prominent ridge on the frontal." In *Loxolophodon cornutus* the naso-maxillary horn is largely above the ŏrbit, and there is no superciliary ridge of the frontal.

"(4) The occiput is not vertical, but extends obliquely backward, the occipital crest projecting behind the condyles." Prof. Marsh has been perhaps led into this error by the imperfection of the occipital condyles in his specimen. He does not appear to know that in life the head was directed obliquely downwards, so that the occipital crest was vertical as I described it in *Loxolophodon* and in *Uintatherium robustum.*

"(5) The temporal fossa is not small posteriorly but unusually large;" and "(7) the spine of the tibia is not obtuse but wanting," are frivolous; *vide* my descriptions, *l. c.*

"(6) The great trochanter of the femur is recurved, though Prof. Cope says not." It is flat, as in the elephants.

"(8) One of the species named by Prof. Cope, *Eobasileus furcatus*, is based on what he regards as portions of the nasal bones. The description, however, indicates that these specimens are merely the posterior horn-cores of well-known species." In the location of these cores Prof. Marsh may be correct, but demonstration is yet wanting. How "well-known" these species are to Prof. Marsh, will be evident shortly; and how they could be well-known to anybody else, may be determined by reference to his brief notices of a few of them published to the date of his writing.

Omitting notice of sundry insignificant questions raised in a postscript to the paper, as well as those which are more or less repetitions of criticisms already made, I pass to his denial of the possession of a proboscis to these animals. I retain my belief that they had such an organ, and refer to my essay above cited for the proofs. Leidy has suspected its presence in *Megaceratops.* He then says "(7th) the malar bone does not form the middle element of the zygomatic arch, but the anterior as in the tapir." It forms the middle element in *Loxolophodon*, as may be seen from my figures. Below, its maxillary support forms one-third of the zygoma, at the side a little less, and above, a narrow lamina of the malar extends nearly to the lachrymal.

"(9) The nasal bones are not deeply excavated at their extremities." They are excavated, etc., as I have described.

Now it is easy to see by an examination of Professor Marsh's figures of *Uintatherium mirabile* where all this blundering criticism comes from, and I have pointed out to him that this is the source of error. But Professor Marsh evidently desires no such consideration from my hands, but repeats his statements, as though *Uintatherium* were a Rosinante, and the ninth commandment a wind-mill.

There is no inaccuracy in my statement of dates of publication of Professor Marsh's genera. I have never stated that the name *Tinoceras* was proposed August 24th, but that it was referred to the *Proboscidia* at that date. This name was published in an erratum on August 19th, but was never described until September 21st and then only by implication in the description of a species. *Loxolophodon* and *Eobasileus* were described August 19th and 20th, with separate diagnoses.

I am charged with giving an erroneous date to his communication of December 20th before the American Philosophical Society. This will also be found to be correct by reference to the report of my communication (Proceedings Academy Natural Sciences, January 14th, 1873).

Having already gone into the discussion of the affinities of these animals, I run rapidly over the characters assigned by Prof. Marsh to a supposed new order *Dinocerea* (which he now spells as corrected, *Dinocerata*). Those from the first to and including the fourth are entirely trivial; the last, which denies air cavities to the cranium is moreover untrue, as they exist in the squamosal region as I have stated. The fifth is not true of all the genera. The definitions from the seventh to the eleventh are of no weight whatever. As the twelfth, he gives "the very small molar teeth and their vertical replacement." This is precisely the state of things in the proboscidian *Dinotherium*, a form which Prof. Marsh has overlooked. The 13th and 15th, "the small lower jaw," and "absence of hallux" are of no weight if true; but the lower jaw has marked proboscidian features in the symphysis and teeth, and it is probable that some of the species had a hallux. The 16th, "absence of proboscis" is probably an error, certainly so for two of the genera. I have passed over the (6th) "the presence of large postglenoid processes," and (14th) "the articulation of the astragalus with both navicular and cuboid bones," as of some value. They are, indeed, the only characters of any wide systematic sig-

nificance adduced by Prof. Marsh, since they point indubitably to the *Perissodactyla* and are common to all of the *Eobasileidæ*. Nevertheless they form but a slim basis of support for an order of mammals, especially when compared with the uniform testimony of proboscidian affinity derived from the cranial expansions, cervical vertebræ, sacrum, pelvis, hind leg, hind foot, scapula, fore leg, fore foot, and the concurrent evidence derived from dorsal and lumbar vertebræ, dentition and proboscis.

If Professor Marsh wishes to see an equal or greater degree of variation in dentition in an order of mammals, let him compare *Equus* and *Rhinocerus* among *Perissodactyla*, or *Bos*, *Moschus*, *Hippopotamus* and *Phacochœrus* in the *Artiodactyla;* in the length of the nasal bones, *Delphinus* and *Squalodon* among *Cetacea*, or *Homo* and some of the lemurs; in the number of toes, *Felis* and *Mustela*, *Ursus*, etc., all members of the same orders.

I should be glad, on the principle of *De mortuis nil nisi bonum*, to commend our critic's remarks on the relations of this supposed order. But Professor Marsh's ideas on classification are derived from unusual sources. The absence of incisor teeth no more relates these animals to the *Artiodactyla* than it relates the sloth to the same order. The presence of paired horns no more constitutes affinity to the ruminants than it does in the case of the "horned-toad."

They are simply an analogous development on a proboscidian basis. The few affinities which this group exhibits outside the *Proboscidia*, are to the *Perissodactyla*, as I was the first to show, and among these, to *Palæotherium* and *Rhinocerus*. As to the name "*Dinocerata*," I have been induced to use it in the sense of a suborder, but am now satisfied that even this use is uncalled for, and shall employ the family name *Eobasileidæ* instead. On equally good bases the camel and *Tragulus* should be erected into new orders.

An explanation of the origin of this new order is probably to be found in the system of Mammalia proposed by Prof. Dana, some years since in accordance with his theory of "Cephalization." While I have been able to see beauty in Professor Dana's conception, the least that can be said is that the application to the Ungulata has not been the correct one. The system has not been adopted, and is in the opinion of the best mammalogists, entirely untenable.

Another critic not so courageous as Prof. Marsh, since he is anonymous, has attacked (Am. Jour. Sci. Arts, 1872, 489) my statement of determination of the Cretaceous age of the Bitter Creek coal, citing five authorities as having previously made the same determination. I have shown (Proc. Acad. Nat. Sci. Phila., Jan. 14, 1873) that but one of these references relates to the region in question, and that the critic was ignorant of the geography or literature of the subject, or both. He, however, repeats (loc. cit., 1873, 231) that Mr. Meek "referred Dr. Hayden's collection from Bitter Creek at Point of Rocks to the Cretaceous," a fact I had previously pointed out, and adds that I am in error in asserting that Mr. Meek attached interrogation marks to all his Coalville determinations (200 miles west), as he cites two *Cardia* and two *Inocerami* as from Coalville and without the question. More careful examination would have shown my critic that the two *Cardia* and one *Inoceramus* are stated to be from localities remote from both Coalville and Bitter Creek.

But there is no indication in my original note of a design to ignore the useful labors of the gentlemen who have written on this subject; nothing was farther from my intentions, in so issuing an early notice of my own observations, than to ignore the opinions of Mr. Meek, with which I have become pretty well acquainted through pleasant association on the same geological survey. Had they been coincident with my own, I should have mentioned them, although unpublished. Mr. Meek will, however, soon speak for himself. It requires but a casual examination to show that the criticism is captious and uncalled for, and that its author is only playing aid to the champion above considered.

II.

I now turn to another subject, the raising of which is due also to Prof. Marsh. He has very commendably made himself acquainted with the literature of the authors who had previously written on these extinct *Proboscidia*, though not in time to prevent his redescribing some of the genera and species. But unfortunately he does not tell us all that he knows. He knows perfectly well that my descriptions antedate his by a month and more, and that he is posterior to Dr. Leidy, by two months at least. He is however not strong enough to state the nomenclature accordingly, but endeavors to prove something else. In order to do

this, he is willing to write (Amer. Journ. Sci. Arts, 1873, p. 118), "the dates on the papers (Aug. 20th and 22d) certainly do not represent those of actual publication;" and again (American Naturalist, 1873, p. 151) "no less than seven of Prof. Cope's papers are antedated, as the records of the society will show." Prof. Marsh is not careful to prevent the natural deduction from these statements, that the dates are fraudulent; though he well knows to the contrary, and disagreeable though it may be to the *mens conscia recti*, I am compelled to prove that such is not the case!

I therefore append testimonials from the proprietors and foremen of the printing establishment from which the essays in question were issued, and from my assistant who received and distributed them:—

PHILADELPHIA, March 24th, 1873.

Professor O. C. Marsh having stated in the "American Naturalist" (1873, p. 151) that some of the papers published by Professor Cope during the summer of 1872, and printed by us, bear dates "which do not represent those of publication" and that "at least seven of them are antedated," we hereby state that these dates are true, and that on the days stated from fifty to one hundred copies of these papers were delivered by us into the hands of Pendleton King and Stephen G. Worth, assistants of Professor Cope, except that on *Metalophodon*, which was issued to Professor Lesley.

McCALLA & STAVELY.

JNO. S. SCHEIDELL, *Foreman of Composing Room.*
JOHN DARDES, *Foreman of Press Room.*

LOUISIANA STATE UNIVERSITY,
Baton Rouge, March 24, 1873.

PROFESSOR E. D. COPE, *Academy Natural Sciences, Philadelphia.*

DEAR FRIEND:—On looking over my papers, I find that I have, among papers written by you, the following:—

On a new genus of *Pleurodira* from the Eocene of Wyoming, July 11, 1872.
On the Tertiary Coals and Fossils of Osino, Nevada, July 29th.
Descriptions of Some New Vertebrata from the Bridger Group of the Eocene, July 29th.
Second Account of Same, August 3d.
Third " " " " 7th.
On the Existence of Dinosauria in the Transition Beds of Wyoming.
Short Notice of Species of Loxolophodon (misprinted Lefalophodon) Cope, near August 17th
tices of New Vertebrata from the Upper Waters of Bitter Creek, Wyoming Territory August 20th.
Second Notice of Extinct Vertebrates from Bitter Creek, Wyoming, August 22, 1872.

These I brought with me from Philadelphia, leaving early in September, 1872.

I laid them aside during July and August, and am confident that the dates which I find on them, as above, correspond with the times I received them from the printer.

Your instructions were for immediate distribution, which I followed, using the list of names of persons to whom they were to be sent. Some received them very soon, others after a short delay, as suited convenience in mailing; and I think all were mailed by the 1st of September.

You are at liberty to use this letter if desirable. Very truly,

PENDLETON KING,
Professor of Natural History in the University of Louisiana.

I now add testimonials from some of the persons to whom the papers in question were sent, although I consider this part of the evidence as quite immaterial, that which has gone before being

sufficient as to the date of publication. It is indeed not to be expected that persons will generally remember the exact dates at which printed matter has been received. Nevertheless in a few days after making inquiry I received the following: —

"Professor O. C. Marsh having stated in the "American Naturalist" (1873, p. 151), that some of the above papers were not published at the dates which they bear, and that "at least seven of them are antedated," I hereby state that most or all the above were received at my address or by me, at or near the dates printed on them, especially those of the summer months."

JAMES ORTON, *Professor of Natural History in Vassar College*, POUGHKEEPSIE, N. Y.
JAMES S. LIPPINCOTT, CORNING, New York.
E. T. COX, *State Geologist*, INDIANAPOLIS, Indiana.
CHAS. M. WHEATLEY, PHŒNIXVILLE, Pennsylvania.
WM. C. KERR, *State Geologist*, RALEIGH, North Carolina.
JOSEPH SAVAGE, LEAVENWORTH, Kansas.

I have also received letters from Principal Dawson of Montreal and Professor Mudge of the State Agricultural College, Kansas, stating that they received the papers, but did not keep exact account of the date of reception. Among many others in the United States to whom they were sent, I may mention Prof. Davidson, President of the San Francisco Academy Natural Sciences. They were also sent to Professors Seeley, Huxley, Gegenbauer, Peters, Hyrtl, Du Bocage and others in Europe, and Messrs. Gotch and Rijgersma in Australia and the West Indies respectively.

I also add that they were received at my address at Fort Bridger, and mostly forwarded to me promptly after the dates of distribution.

The little that interests students in this matter is the dates of publication of the essays in question. The dates of reading are of secondary importance and have been abandoned by naturalists generally as furnishing basis for nomenclature, so that Prof. Marsh's able criticism of the dates on the cover of the American Philosophical Society's proceedings for 1872 may be regarded as purely antiquarian. The papers in question were, in fact, issued independently of the society, and almost always in advance of the time at which they were read before it. But lest our bibliophile again charge me with fraud, let me here correct an error in the report of the proceedings of that society for August, 1872, in "Nature" for 1873, p. 335. Here it is stated that my first note on the Proboscidians was read on August 16th; I hasten to say that this is an error probably derived from the wording of the note as published on August 19th, in which it was stated (without my knowledge) that "The Secretary announced that he had re-

ceived from Prof. Cope," etc. This could only have referred to the last meeting preceding (on the 16th); but, in fact, it was not read until the meeting following (September 20th). In the mean time it had been published (on the 19th), and two other papers describing the species and genera in more detail were published on the 20th and 22nd respectively. An account embracing the same facts was also read by Prof. Winchell before the American Association for the Advancement of Science, which opened its sessions at Dubuque on August the 21st (or 23d), of which an abstract has, after great delay, appeared in the American Naturalist for March, 1873. Finally a description of *Eobasileus* appeared in the scientific column of the "New York Independent" for August 22nd, 1871. The papers published in Philadelphia were issued without my revision, and hence contain a few typographical errors which Prof. Marsh finds of great use to himself. But under the circumstances the number is surprisingly few.

I now present a table of the nomenclature of the three genera of *Proboscidia*, synonymy being in italics: —

MONTH.	AUTHOR.		
	Leidy.	Cope.	Marsh.
August, 1872.			
1st.	Uintatherium described with one species. *Uintamastix* do.		
19th.		Loxolophodon described with three species.*	*Tinoceras* used in erratum, not described; no species described.
20th.		Eobasileus described and one species.	
22d.		Loxolophodon again described with three species.	
24th.			*Tinoceras* named; no description.
September.			
21st.			*Tinoceras* described with one species described.
27th.			*Dinoceras* described with two species.

* In this communication the name *Loxolophodon* was misspelled Lefalophodon. As Prof. Marsh finds some difficulty in adopting the former name, I can accept the latter, should he insist on it.

Though Prof. Marsh has published five papers and six notes on these animals, but one of his species has been so far partially described as to be of any use to science. Publishing of bare names * may constitute a caveat, but not an injunction, but in the present case the dates are too late. Hence the trouble. "*Heu quantus erat sudor*," etc.

In one of Prof. Marsh's late catalogues, he asserts that *Loxolophodon cornutus* and *Tinoceras grandis* are identical. If this be true, the latter name must stand as a synonyme of the former, and *Tinoceras* be withdrawn from the synonymy of *Uintatherium*, where it might well remain so far as his description characterizes it. But if so, his statement that there are five superior molars must be altered, as the genus *Loxolophodon* possesses six. He has also stated that *Uintatherium robustum* possesses a small tubercle on one of the molars not found in *U. mirabile*, and bases a generic distinction between the species thereon; for use he at last succeeds in defining the latter as a species only.

Perhaps, however, Prof. Marsh desires to impose upon scientific literature the numerous names he has proposed for species he has never described.† This he has attempted in the case of the fossil American Turkey, *Meleagris superbus* Cope, which was described by the writer over a year sooner than by him. At the latter date this species was discovered to have been called *M. altus* Marsh, some months prior to my description, but without any allusion to its characters or other means by which it could be identified. If Prof. Marsh desires students to use his museum labels, without descriptions, he might refer to Bronn's "Lethæa Geognostica," and other works, where he will find all such names consigned to the rubbish of synonymy so soon as it can be ascertained to what they refer.

To sum up the matter, it is plain that most of Prof. Marsh's criticisms are misrepresentations, his systematic innovations are untenable, and his statements as to the dates of my papers are either criminally ambiguous or untrue. I might now proceed to

* See the rule "adopted and practiced by most students. In case of a genus there must be a definition giving the essential characters." From "Thorell's European Spiders," quoted in Wallace's Address before the Entomological Society. London. and by W. H. Edwards in "Entomological Nomenclature" in "Canadian Entomologist." 1873, p. 32.

† Several of which owe their existence in literature to the descriptions which I have given, *e.g.*, *Thecachampsa squankensis* "Marsh," *Hadrosaurus minor* "Marsh."

characterize the effrontery of such proceedings in fitting terms, but forbear, believing that with a little change of scene the author of them will be as glad to bury them in oblivion as is the writer of this notice.

EXPLANATION OF PLATES.

PLATE 4. Front view of cranium of *Loxolophodon cornutus*, one-sixth natural size.
PLATE 5. Profile of the same (not in natural position) same proportion; compare with description.

NEW PLANTS OF NORTHERN ARIZONA AND THE REGION ADJACENT.

BY SERENO WATSON.

In the botanical collections made in 1871–'72, mainly in the southern portion of the Great Basin, in northwestern Arizona and the adjacent desert section of California, by Mr. Ferd. Bischoff and others, under the direction of Lieut. G. M. Wheeler, Corps of Engineers, in the course of his exploration of that region, several new species have been found which are here described, by consent, in anticipation of the fuller report now in preparation. With these are given some others occurring in a small collection made by Mrs. Ellen P. Thompson near Kanab, Southern Utah, during the last summer while accompanying her brother, Maj. Powell, in his survey of the Colorado. Several of these species are of interest as confirming genera hitherto monotypical. Notes upon a few other species are added.

POLYGALA SUBSPINOSA.—Perennial, herbaceous, glabrous or more or less pubescent; stems 2–8' high, branched above, the branches often spinose; leaves scattered, ½ to 1' long, oblong or oblanceolate, acute or obtuse, attenuate to the base; raceme loose, few-flowered; bracts small and scarious; pedicels becoming reflexed, shorter than the flowers; sepals naked or ciliate, the wings oblong, 4–5'' long and equaling the petals; keel hooded, crested with a broad saccate process; style linear; capsule orbicular, emarginate, short-stipitate.—Near *P. Nutkana*, which has a linear or horn-shaped crest and is always nearly or quite glabrous and without spines. Silver City, Nevada (Kellogg, 1862), pubescent and very spiny; Arizona (Palmer), densely pubescent but without spines; Kanab (Mrs. E. P. Thompson), glabrous and spiny. Flowers "maroon and yellow;" on mountain summit; June.

PETALOSTEMON FLAVESCENS.—Stem simple, glabrous; stipules and leaves sparingly silky; leaflets 3–5, narrowly oblong, obtuse, 3–6'' long; spike dense, long-peduncled, the rachis subpubescent; bracts (and calyx) very silky-villous, subulate, 2'' long; upper tooth of the calyx subulate, narrowest and longest, equaling the tube; petals yellow, the limb of the banner quadrilateral, emarginate, equaling the claw, the

other petals narrowly oblong.—Kanab, Southern Utah (Mrs. E. P. Thompson), on dry rocky hills; June. *P. macrostachyus*, Torr., a somewhat similar, more northern species, with elongated spikes of white flowers, has 5-9 acute glabrous leaflets, the rachis, bracts and calyx very villous, the subulate bract long-acuminate, calyx-teeth equaling the tube, and the claw of the banner much exceeding the small deltoid-subcordate irregularly crenate limb.

In the collection from Kanab is another well-marked form, but probably referable to *P. Searlsiæ*, Gray—differing in the broad naked bract, rhomboidal above with a short filiform apex, attenuate to the base; calyx equally villous throughout; petals larger and broader, the banner entire or emarginate instead of crosely crenate. *P. ovatus*, Dougl., from Oregon, with violet flowers, is distinct from *P. macrostachyus*, to which it has been referred. There are other western species as yet undescribed.

Dalea amœna.—Shrubby, much branched; pubescence short, silky, dense only in the upper axils; leaflets 7-11, narrowly linear, 3-4″ long, obtusish; flowers loosely racemed, few, large, deep-purple; pedicels 1″ long; calyx pubescent, 3-5″ long, the lanceolate acuminate teeth equaling the tube; petals 6″ long; ovary densely pubescent.—Allied to *D. Fremontii*, *Johnsoni* and *Schottii*. Northern Arizona (Mrs. E. P. Thompson). In damp places; April.

Astragalus ampullarius. (§ *Inflati*.)—Stems short, ascending; pubescence short, strigose, appressed; leaflets 7-11, obovate, 4-6″ long, emarginate, glabrous above; raceme short, ½-1′ long, rather dense; calyx cylindrical-campanulate, 2-3″ long, the teeth very short or nearly obsolete; petals purple, the banner narrow, 7-9″ long, much exceeding the very obtuse keel; legume ascending, upon a long-exserted stipe, oblong, 9″ long, glabrous.—Kanab, Southern Utah (Mrs. E. P. Thompson). In damp places; April, May.

Peteria Thompsonæ.—More or less hoary with short appressed hairs; stems herbaceous, 1° high or more; leaflets 6-10 pairs, obovate, 4-6″ long, obtuse, mucronulate; raceme dense; bracts linear-setaceous; calyx densely glandular-pubescent, the subulate teeth about equaling the tube and slightly shorter than the light-yellow corolla; banner orbicular, 6″ long; ovary sessile; pod 2′ long, 2″ wide, glabrous, about 6-seeded. —Stipules spinose as in the original species, not subulate as described by Bentham and Hooker. The base of the style in both species is thickened and somewhat horny. Kanab (Mrs. E. P. Thompson). On dry rocky cliffs; July, August.

Whipplea Utahensis.—Shrubby, low (6′ high), much branched; pubescence strigose, mostly appressed; leaves oblong, attenuate to a very short petiole, 3-5″ long, acutish, entire, sparingly hairy, 3-nerved; flowers small, few, on very short pedicels, in a dense compound cyme; calyx cylindrical-turbinate, the subulate lobes shorter than the white oblong clawed petals; stamens 10; styles 3 and ovary 3-celled; capsule oblong, terete, 1½″ long, adherent for half its length to the calyx-tube.—Especially distinguished from *W. modesta* by its elongated capsule. Bud-scales very silky. Kanab (Mrs. E. P. Thompson). On dry sandy cliffs; August.

Œnothera (Chylisma) multijuga.—Annual, glabrous, branched; radical leaves 6′ long, narrow, pinnate with 12 or more pairs of leaflets, which are 9″ long, the alternate ones smaller, oblong, acute, irregularly and doubly toothed, strongly veined, the terminal leaflet not larger; raceme loose; pedicels slender, 1½′ long, equaling the filiform angular ovary; calyx-tube 1-1½″ long, much shorter than the segments; petals yellow, 4″ long.—Near *Œ. scirpoides*, Nutt., but none of the forms of that variable species shew any approach to this in the regular pinnation and peculiar serration of the leaves. Northern Arizona (Mrs. E. P. Thompson). In dry places; March.

Petalonyx nitidus. Leaves ovate, ½-1′ long, acute, coarsely toothed, shortly petioled, vitreous and shining, not greatly reduced on the branches; flowers in contracted cymose panicles; otherwise like *P. Thurberi*.—Southern Nevada (Wheeler).

Cymopterus purpureus.—Subacaulescent, glabrous; leaves 2-3-pinnate, broadly triangular in outline, 2-4′ long including the petiole, the broad segments coarsely mucronate-dentate; peduncle stout, exceeding the leaves; umbel unequally 8-12-rayed, naked or with a single involucral bract; involucels unilateral, of several lanceolate segments united near the base, nearly equaling the flowers; sepals ovate, acute; petals yellowish-purple; fruit 4″ long, nearly as broad, with wide membranous wings, the pedicels as long or longer; seed concave, 3 costate, one or all of the corresponding

wings developing; vittæ 4-5 in the intervals, 8 upon the commissure.—Whole plant purplish; near *C. terebinthinus*, Nutt. New Mexico (Palmer, 1869). Northern Arizona (Mrs. E. P. Thompson). In damp, shaded soil; March.

PEUCEDANUM NEWBERRYI.—Acaulescent or nearly so, glabrous or somewhat viscid-pubescent; leaves ovate or oblong in outline, 1-2' long, shorter than the petioles, pinnately 3-foliate; upper leaflet 3-lobed, the lower 2-lobed and sessile, lobes sparingly incised; peduncle exceeding the leaves; umbel naked, unequally 4-8-rayed; involucels foliaceous and unilateral, the 4-8 very unequal segments oblong, acute or obtuse, mostly exceeding the flowers; calyx-teeth ovate to linear-lanceolate, acute; petals yellow; disk broad; fruit glabrous, ovate, exceeding the short pedicels.— Remarkable for its conspicuous foliaceous involucels. Fruit immature, but sufficiently grown to show its character. New Mexico (Dr. Newberry, on the Mexican Boundary Survey); Northern Arizona, on stony soil (Mrs. E. P. Thompson). April.

ANGELICA WHEELERI.— Tall and stout, roughly puberulent; leaves biternate; leaflets ovate-oblong, 2-3' long, acute, incisely serrate, the teeth broad and mucronulate, middle leaflet petiolulate; involucre and involucels none; rays numerous, unequal, becoming 2-5' long; pedicels and ovary hispid; petals apparently white; fruit broad-elliptical, 3'' long, subpubescent, the dorsal wings thick, narrower than the lateral ones.—Utah (Wheeler).

GARRYA FLAVESCENS. (*Garrya* ——?, Watson, *King's Rep.* 5, 421).— Pubescence silky, appressed; leaves elliptic-oblong, 1-2½' long, acute at each end, entire, glabrate above, margin revolute; petioles 3-6'' long; aments pendulous; bracts 6-10 pairs, broad-ovate, connate, foliaceous, acute or the lower acuminate; sterile aments 1-2' long, loose, the flowers (1-3 together) on pedicels equaling or exceeding the bracts; fertile aments 1' long, dense, with solitary flowers and densely pubescent fruit.— Frequent from Southern Nevada and Utah to Arizona and New Mexico; growing 5-8° high, and flowering in March.

BRICKELLIA (CLAVIGERA) LONGIFOLIA. — Slightly scabrous, very slender, with spreading branches; leaves 2-5' long, linear, acuminate, entire or obscurely sinuate-toothed, flat with scabrous margins, 3-nerved, punctulate; flowers on short slender pedicels, axillary and in small terminal clusters; involucre glabrous, 2'' long, the spreading scales acutish, or the linear inner ones obtuse or truncate; achenium 10-striate, slightly and minutely hairy on the angles, nearly 1'' long, the soft minutely barbulate pappus but little longer.—Southern Nevada (Wheeler); Northern Arizona (Mrs. E. P. Thompson). In a damp cañon; April.

HAPLOPAPPUS CERVINUS.— Low, 6' high, suffruticose, resinous-scabrous, the short herbaceous stems leafy to the top; leaves oblong-lanceolate, 4-6'' long, shortly cuspidate, attenuate to the base, entire, subscabrous, 3-nerved; heads 3-4'' long, in 3-5-flowered terminal corymbs; outer scales linear, acuminate, with setaceous spreading tips, the inner chartaceous, acutish, with scarious lacerated margins, erect, nearly equaling the pappus; rays few, narrow and short; style exserted; achenia linear, pubescent.— Nearest to *H. suffruticosus*, Gray. Antelope Cañon, Utah (Wheeler).

LAPHAMIA MEGALOCEPHALA.— Scabrous-pubescent; stems diffusely branched, 1° high; branches simple; leaves alternate, broadly ovate, 2-3'' long, smaller upon the branches, entire, very shortly petioled; heads large, 2-3'' in diameter, terminal and solitary, discoid, many-flowered; achenia compressed, hispid; pappus none.— With nearly the habit of *L. Stansburii*, Torr. Nevada (Wheeler).

VIGUIERA RETICULATA.—White-tomentose; stems herbaceous; leaves subopposite, coriaceous and rigid, broad-ovate, 1-2' long, cordate at base, acute, entire, shortly petioled, strongly reticulated beneath; bracts small, lanceolate; heads 4-5 together in short close corymbs; involucral scales imbricated in 3-4 series, lanceolate, thick, appressed or with spreading tips; rays entire; receptacle shortly conical; chaff acutish; achenia silky, the pappus-awns subulate at base, the scales lacerate.—Telescope Mountain, Southeastern California (Wheeler).

CHÆTADELPHA * WHEELERI, Gray MS.—Stems numerous, 1° high, flexuous; leaves

* CHÆTADELPHA, Gray MS. (New Genus of *Cichoraceæ*). Heads about 5-flowered. Involucre cylindrical, of 5 linear 1-nerved scales in a single row and several small imbricated scales at base. Receptacle naked. Ligules short. Achenia linear, glabrous, 5-angled, somewhat striate between the prominent angles, slightly thickened upward. Pappus of a single row of

linear-lanceolate, 1-2' long, acute, entire, rather rigid; flowers apparently rose-color; involucre 6'' long, shorter than the brownish pappus; achenia 3-4'' long.—With the habit of *Lygodesmia juncea*. Southern Nevada (Wheeler).

GILIA (NAVARRETIA) DEBILIS.—Slender, 1-2' high, leafy above; pubescence minute or hirsute; leaves alternate, ½-1' long, oblong, attenuate into a short petiole, entire, or some of them broader and 3-lobed; bracts entire, resembling the leaves, twice longer than the calyx; flowers nearly sessile; calyx-teeth ovate-triangular, shorter than the tube; corolla funnel-form, 8'' long, with elongated tube and deeply lobed limb, light-purple; the stamens upon the throat, exserted; capsule 1'' long, the cells 1-seeded; seeds without mucilage or spiracles.—Utah (Wheeler). Without the pinnatifid pungent lobing of the leaves and bracts which is usual in the section.

CONVOLVULUS LONGIPES.—Glabrous, glaucous, twining; leaves linear, 1' long or less, entire or auricled at base, petioled; peduncles elongated, 2-6' long, mostly strict, 2-3-bracted, usually 1-flowered; bracts linear; calyx-lobes rounded, obtuse or emarginate; corolla funnel form, 1½' long, yellowish.—Southern Nevada (Wheeler).

FRAXINUS CORIACEA.—Leaflets 3-5, coriaceous, obovate or oblong, 1-2' long, truncate or rounded at the apex or acutish, attenuate or abruptly contracted at base, sparingly toothed, mostly rather long-petiolulate, glabrous, or with the petioles pubescent when young; fruit 1' long, terete at base, widening into an oblong obtuse wing; calyx persistent.—Ash Meadows, Nevada (Wheeler), and Devil's Run Cañon, Arizona (Bigelow), on the Mexican Boundary Survey.

OXYBAPHUS GLABER.—Glabrous; panicle large and open; bract-leaves oblong, sessile; flowers solitary, on slender pedicels 2-3'' long, becoming deflexed; involucre 1-flowered; calyx shorter than the involucre; fruit glabrous, oblong, strongly tuberculate between the prominent ribs.—Lower leaves not collected but the species is otherwise strongly marked; fruit much as in *O. glabrifolius*. Kanab, Utah (Mrs. E. P. Thompson). In dry soil; October.

ABRONIA VILLOSA.—Pubescence more or less densely villous, subglandular, spreading; stems weak and slender; leaves ½-1' long, oblong or ovate, obtuse or acutish, attenuate into a slender petiole; heads 5-10-flowered; involucral scales narrowly lanceolate, long-acuminate, 3-4'' long; flowers pink, the lobes obcordate with a deep sinus; fruit with a firm body, strongly reticulate-pitted, the 3-5 broad wings consisting of a simple lamina, usually truncate above.—Nearest to *A. umbellata*. Arizona (Wheeler).

ERIOGONUM THOMPSONÆ. (§ *Corymbosa*).—Branches short, subwoody, ascending, leafy, bearing a long naked peduncle; stem, petioles and under surface of the leaves white-tomentose, otherwise glabrous; leaves broad-oblong, 1½' long, acute at each end, long-petioled; scape 1° high, rigid, repeatedly trichotomous above, and tribracteate at the nodes; involucre 5-toothed and strongly 5-angled; flowers yellow, naked, the segments of the perigonium nearly equal.—Whole plant yellowish. Sand-cliffs near Kanab, Utah (Mrs. E. P. Thompson). September.

QUERCUS UNDULATA, Torr.—The common low oak of the Rocky Mountains and Wahsatch, ranging southward to New Mexico and Southern Utah. An examination of considerable material shows that it is quite variable in its foliage and includes several reputed species and forms. The typical form has oblong leaves with acute or acutish entire divaricate mostly triangular lobes, the sinuses reaching half-way to the midrib. This is also *Q. Fendléri*, Liebm. With large leaves and the lobes sometimes coarsely notched it becomes *Q. Gambellii*, Nutt., and *Q. Douglasii*, var. *Neo-Mexicana*, A. DC. With the lobes more obtuse it is *Q. alba*, var. (?) *Gunnisoni*, Torr.; and with the lobes less divaricate and more oblong, frequently notched at the apex, and the rounded or narrow sinuses reaching often nearly to the midrib, it is the more prevalent northern form, *Q. obtusiloba*, var. *depressa*, Nutt., and var. *Utahensis*, A. DC. The extreme states appear quite distinct, but intermediate forms abound and there seems to be nothing in the flowers or fruit to distinguish them.

SALIX NEVADENSIS.—Aments short, 6-8'' long, appearing with the leaves, ascending on leafy peduncles; scales oblong, obtuse, glabrous, or subsilky in the male aments, light-colored; stamens 3, free; capsules glabrous even when young, on pedi-

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barbulate bristles, those at the angles stout and rigid, the few intermediate ones shorter, capillary and more or less united to them.—A smooth, diffusely branched, herbaceous perennial, with alternate leaves and solitary terminal flowers.

cels ½'' long; style none; stigmas short and thick; leaves lance-linear, ½-1' long on flowering specimens, acuminate, entire, silky-tomentose; stipules very minute.—A slender shrub, 3-4° high, with light-colored bark and yellowish foliage, growing in dry sandy soil. It differs from *S. Hindsiana* in its more reduced habit, its silvery pubescence, narrower, more scarious, lighter-colored and glabrous scales, more slender and smoother capsules, and thicker and shorter stigmas. At the base of the Washoe Mts., near Carson City (1093 Watson), and in Central Nevada (Wheeler).

CALOCHORTUS AUREUS.—Low, 4-6' high, with a single linear carinate radical leaf, 3-4' long; scape short, 1-2-flowered, the single pair of bracts linear, 2' long; sepals greenish-yellow, with a dark-purple spot near the base, oblong- or ovate-lanceolate; petals broadly cuneate, 15'' long, bright-yellow, with a small well-defined circular densely hairy gland near the base and a lunate purplish spot above it; young capsule narrowly oblong, not winged.—On sand-cliffs, Southern Utah (Mrs. E. P. Thompson); June.

CALOCHORTUS FLEXUOSUS. — Branched and flexuous above; bracts alternate, ½-1½' long, linear-lanceolate, carinate, rather rigid; sepals oblong-lanceolate, greenish with a deep-purple and orange spot at base; petals broadly cuneate, 12-15'' long, purplish, with a deep-purple claw and an ill-defined circular orange or purple gland above, the glandular hairs extending laterally to the margin; capsule triangular, narrowly oblong.—Southern Utah and Northern Arizona (Mrs. E. P. Thompson); April and May. The bulbs, as of other species, are eaten by the Indians.

ANDROSTEPHIUM BREVIFLORUM.—Scapes 6' high; umbels 4-7-flowered, the pedicels 6-15'' long; perianth violet, 6-7' long, the nearly erect lanceolate segments equaling the campanulate tube; corona 3'' long; capsule triangular-globose, 3'' in diameter.—A stouter plant than *A. violaceum*, with much smaller flowers. Southern Utah and Northern Arizona (Mrs. E. P. Thompson); April and May. Bulbs also eaten.

ON THE DATES OF PROFESSOR COPE'S RECENT PUBLICATIONS.*

BY PROF. O. C. MARSH.

DURING the past year Dr. Leidy, Prof. Cope, and myself have been investigating the fossil vertebrates of the Eocene of Wyoming, and our material has not unfrequently included the same species. Our descriptions have usually been published as separate papers, issued in advance of the journals containing them. To prevent, if possible, any question about priority of publication I agreed with each of these authors in March, 1872, that we should send to each other, on the day of publication, any papers on the above subject we might issue, the date of publication to be either printed or written on each pamphlet. This would ordinarily secure the receipt of the papers on the following day, and we agreed to accept this receipt, so far as we were individually concerned, as

* Communicated to the Philadelphia Academy of Natural Sciences, April 8th, 1873.

publication. This agreement Dr. Leidy has scrupulously observed, and I have myself carefully kept it.

Between July 22d and October 8th, 1872, I published a series of fourteen papers on vertebrate fossils from the West, and in every instance mailed copies to Prof. Cope and Dr. Leidy on the day of publication, and, of the more important papers, a second copy by a subsequent mail, as we had also agreed. Believing, with most naturalists, that publication of a paper by means of advance copies can be fairly done only by making these copies accessible to those working in the same department, I likewise sent copies of each of my papers, on the day of publication, to the principal scientific centres in this country which are especially interested in this subject, namely: Professor Baird of the Smithsonian Institution; the Museum of Comparative Zoology in Cambridge; the Boston Society of Natural History; the editors of the American Naturalist; the editors of the American Journal of Science; the Academy of Natural Sciences in Philadelphia and the American Philosophical Society. I also promptly placed these pamphlets on sale at the Naturalists' Agency in Salem, and sent early copies to palæontologists in Europe, and to various scientific journals. That these papers were duly received, the records of the above societies, and the reviews and notices in several periodicals, as well as letters from correspondents, afford ample testimony. The papers subsequently appeared in successive numbers of the American Journal of Science, from August to November, 1872.*

During this period of over three months, in which these various papers were being published, I received nothing of the kind from Prof. Cope. An intimation from a friend finally led me to think that this author might, perhaps, have published something which had accidentally failed to reach me, and, as it was important to have this settled, I made inquiries at each of the above points in this country where I had sent my papers, and soon ascertained definitely, that no publications by Prof. Cope, issued subsequent to July 1st, 1872, had been received. The inquiry was diligently extended, also, among American naturalists, especially those who would be most likely to know of such publications, but no evidence of a single copy could be obtained. This was the case up to October 8th, 1872, when the last paper of my series was published, and I started for the West.

* Vol. IV, pp. 123, 202, 256, 298, 322. 323, 343, 344, 405 and 406.

About a month after this, or November 5th, 1872, five papers by Prof. Cope were received at New Haven, and, on the 11th of that month, five more, which were all forwarded to me at Cheyenne, Wy. A third lot reached New Haven, December 4th, 1872, and was given to me on my return a few days later. In these various papers, which were mostly uncorrected proofs, several genera and species, which I had described three months before, are re-named by Prof. Cope. The papers, moreover, bear dates from July 11th to October 12th, 1872, and thus might appear to anticipate part of my descriptions, in some cases only by a single day. These papers purport to have been read before the American Philosophical Society, but the official records of that Society show that they were not even presented until long after the dates claimed for them. They have since appeared in the Proceedings of that Society, Number 89 * (published February 6th, 1873), more than three months after my last paper had appeared in the American Journal of Science.

On learning of the distribution of these papers by Prof. Cope, I renewed my inquiries about their true dates of publication, and found that copies were first received, October 29th, 1872, by the Philadelphia Academy of Natural Sciences, of which Prof. Cope is secretary, and that apparently none were distributed at an earlier date. Wishing, if possible, to avoid bringing this matter into public notice, I informed Prof. Cope, personally, that I could find no evidence of any copies of his papers being distributed before October 29th, 1872, and requested him, if he claimed an earlier publication, to inform me where any of these papers had been sent. He at first declined to do this, but finally mentioned five addresses in this country and Europe, to which the papers in question had been duly forwarded, during his absence, by the person entrusted with their distribution. I have since learned from two of these places that nothing definite is known of these papers, and from the other three I have a positive assurance that none of them were received.

It thus becomes evident that these papers by Prof. Cope were not published at the time claimed, and I protest against the dates they bear being accepted as authentic. Publication of scientific results means *making them known*, especially to those interested, and cannot be claimed where these results are so carefully withheld

* Vol. XII, pp. 460, 466, 469, 472, 478, 481, 483 487, 542, 554 and 580.

that no record of them can be found by diligent inquiry. The few species at stake in the present case are comparatively of little consequence, but the principle involved is all important, and if disregarded, scientific nomenclature will become worthless, and honest research lose its just reward.

TINOCERAS AND ITS ALLIES.

BY PROFESSOR O. C. MARSH.

SINCE the article on page 217 of the April NATURALIST was printed, another pamphlet by Prof. Cope on the same subject has been received (March 20th). In this paper, which is dated March 14th, 1873, and illustrated by four plates, Prof. Cope has at last adopted nearly all my views as to the characters and affinities of the *Dinocerata*, as well as most of my corrections of his errors, although without giving credit in either case. Unfortunately, he still misinterprets the structure of this group on several points, and most of his dates are incorrect as before. On nearly every page of the paper, moreover, new errors may be detected, a few only of which can be corrected here, for want of space.

1st. Prof. Cope is wrong in assigning only three sacral vertebræ to the *Dinocerata*, as *Dinoceras*, the type of the group, certainly has four, and the other genera probably as many. 2d. The neck in *Tinoceras grandis* Marsh (or ? *Tinoceras cornutus*) was much more than a foot in length, rather than less, as the cervicals in the Yale Museum clearly prove. 3d. Prof. Cope is entirely in error in saying that the muzzle in this species could not reach the ground by several feet; the animal really having no use for the long proboscis which Prof. Cope persists in putting on him. 4th. The specimen described as *Eobasileus cornutus* was fully adult, as the teeth show, and the differences between it and the type of *Tinoceras grandis* may be due to age. 5th. The nasal bones in this genus do not form the inner half of the middle horn-cores, but only a small portion of the base, the cores being essentially on the maxillaries. 6th. The anterior extension of the malar bone is not in *Dinoceras* much less than in Perissodactyls. 7th. The

tusks figured in plate I of Prof. Cope's paper are not in their true position, and in plate II the left tusk is placed on the right side, thus entirely reversing its characters. 8th. The name *Loxolophodon* was not applied to the genus *Tinoceras*, Aug. 19th, 1872, but long afterward, and then altered to *Lefalophodon*, with specific names all different from those now claimed. A good example of the inaccuracy which seems inseparable from Prof. Cope's work is seen in the explanation of the plates of this paper, where two serious mistakes occur in the first line.

Prof. Cope concludes with some remarks about nomenclature, evidently aiming to save, if possible, some of his names which are anticipated by mine. His views as to what constitutes publication are absurd, and would not be accepted by any scientific authority. His precepts about describing genera may be fitly compared with his practice, without going beyond the *Dinocerata*. The name *Loxolophodon* Cope was first given, without description, to a genus which Prof. Cope now rejects, and when again applied, contrary to usage, to the genus *Tinoceras*, all the generic characters mentioned existed only in that author's imagination.

In a late number of "Nature" (February 27th, Vol. VII, p. 335), there is a report, written by Prof. Cope, of various meetings of the American Philosophical Society. This report, which was unauthorized by the society, contains several important misstatements. Under the meeting of August 16th, 1872, it is stated that "A communication from Prof. Cope was read on his discovery of '*Proboscidia* in the Wyoming Eocene,' * * * a new genus, *Eobasileus*, was described." The official records of this society show that no paper with this title, or on this subject was read at this meeting, and none was even presented until more than a month later, or September 20th. This misstatement is a serious one, since it is likely to mislead European naturalists as to the paper thus antedated. The description of "*Eobasileus*" as quoted in this report is quite different from that given in the paper when read, or as since published (February 6th, 1873), in the Proceedings of the Society, Vol. XII, p. 485. This makes at least the sixth time this genus has been antedated, and its supposed characters changed by Prof. Cope within as many months.

A circular has lately been issued by Prof. Cope requesting signatures from those who received his papers, the dates of which I have questioned. This circular quotes from my note on page 151,

but the quotation is incorrect, and conveys a very different meaning from the original. A signature to this circular can have no weight in the present discussion, as the document is so worded that it calls for no definite information whatever in regard to the real date of publication of any one of the doubtful papers. In this respect, and in its inaccuracy, the circular resembles perfectly Prof. Cope's other publications which I have recently criticised.

REVIEWS AND BOOK NOTICES.

A Text-book of North American Ornithology. — Suitable manuals of zoology, treating of single classes of animals, have hitherto been desiderata in our zoological literature. The subject of the present brief notice — Dr. Elliott Coues' "Key to North American Birds"* — is a work unique in its conception, and the first of a kind one may well hope to see soon supplied for each class of our native animals, and especially for the several classes of the vertebrates. In these classes the number of species is small in comparison with the number of species of insects and of plants, and can be readily comprised in a volume of convenient size for a hand-book. Gray's admirable series of botanical text-books furnish guides to our flora that render accessible to the ordinary student and amateur a general knowledge of our plants, but until now we have had no similar handbook for any department of zoology.

The character of Dr. Coues' work, so far as fidelity of treatment and scientific accuracy are concerned, is sufficiently endorsed by the high character of his various special memoirs and monographs, and his high standing as an original investigator. The value of his "Key" as a text-book of American ornithology may be regarded as two-fold; first, its clear exposition of the latest and most generally approved views of the subject treated, and, secondly, its scope and the arrangement of the subject matter itself. A general "Introduction" treats of the leading principles of ornithology, and describes in detail, aided by suitable illustrations, the external

* Key to North American Birds, containing a concise account of every species of Living and Fossil Bird at present known from the Continent north of the Mexican and United States Boundary. Illustrated by 6 Steel Plates and upwards of 250 Woodcuts. By Elliott Coues, Assist. Surg. U.S. Army. Salem: Naturalists' Agency; New York, Dodd & Mead; Boston, Estes & Lauriat, 1872.

parts and organs of the bird, with full explanations of the technical terms used in descriptive ornithology. This is followed by a "Key" or artificial analysis of the genera of North American birds, similar in plan to the artificial analytical tables employed in botanical manuals as a guide to the families of plants. The student being fitted to intelligently use the "Key," by a careful study of the "Introduction" which precedes it, the "Key" enables him without previous special acquaintance with the subject, to find the name of any species of bird occurring in North America, north of Mexico, he may chance to have. In the "Synopsis" which follows the "Key," and which forms the chief bulk of the volume, are given concise, admirably clear diagnoses of the species and varieties of our birds, with indications of their geographical range. The higher groups are also quite fully and satisfactorily characterized, including the exotic as well as the indigenous forms; and the classification adopted is probably the one most generally approved by leading ornithologists. The diagnoses are illustrated by upwards of two hundred figures of such parts as are most useful in classification. Following the general synopsis of the living forms, is a concise account of the fossil species, twenty-nine in number, which has the great merit not only of being the work of the highest authority on the subject, but of being the first and only general exposition of this department of American ornithology.

While, perhaps, not above criticism in respect to occasional minor details, it is a work not only especially designed for students and amateur ornithologists, but one well calculated to meet the end in view, and as such entitles the author to the gratitude of all beginners and even somewhat advanced students of American ornithology.—J. A. A.

BOTANY.

A Blue Anagallis.—Dr. Gray recognizes the fact that *Anagallis arvensis* L., occurs sometimes not only with purple and even white flowers, but also with blue ones. Of course it is well known to restrict itself, usually, to a rather peculiar red. I have this season found near my house a vigorous plant bearing flowers of most beautiful and decided blue, which is the first instance within my observation. I would like to know how common this form is, and whether it is not a singular characteristic that one species should thus exhibit two of the primary colors, as I remember no other

such case except in shrubs induced by cultivation. I am unable to detect in the plant before me any difference from the common form, unless, perhaps, less pointed petals and somewhat narrower leaves.— C. M. Tracy, *Lynn*, *Mass.*

Epigæa repens.—This plant deserves a more careful examination than it has yet received. The infrequency of the occurrence of fruit has been explained in different ways, but no satisfactory explanation has yet been offered. In the "Botanical Register," vol. 3, p. 201, the following statement occurs: —"Some of the corollas are frequently found to be sterile; and, according to Michaux, it would appear that the species was diœcious, the flowers being sometimes barren throughout in individual plants." Mr. Meehan has called attention to the great degree of variation which occurs in many of our native wild plants, this among the number, and it is to be earnestly hoped that our botanists will commence early to make more critical observations respecting variations in such cases. A series of carefully conducted experiments in regard to the cross fertilization of Epigæa is much needed. Owing to the great facility with which such experiments can be performed, we are confident that some of our readers will take the matter in hand.

Dimorphic Flowers of the Ipécac Plant.—Prof. Balfour of Edinburgh has given to the Royal Society of Edinburgh, a very interesting account of dimorphism in the flowers of *Cephaëlis Ipecacuanha*. The plants in the Edinburgh Botanical Garden were derived from two sources; in one case the flowers have long stamens and short styles. In the other case there is distinct dimorphism. Some of the flowers have long stamens and a short style; others short stamens and a long style. Successful fertilization has followed the application of the pollen from one form to the stigmas of the other form. It will be remembered that this plant belongs to the order *Rubiaceæ*. This order gives us one of the very best common instances of dimorphism, *Houstonia cœrulea*, clearly described in Dr. Gray's "How Plants Behave."

Iodine in the determination of Fungi.— Some of our readers are acquainted with the use of chemical re-agents made by Nylander in the study of lichens. This application has led to the idea that a similar use of chemical tests may be adopted in the determination of fungi. In the Feb. (1873) number of the "Journal

of Botany," Mr. Phillips gives some facts respecting the employment of tincture of iodine for this purpose. The re-agent used is the common tincture of iodine, diluted to one-half with alcohol.

A drop of this is placed on a glass slide with a thin section of the hymenium and subjected to a slight pressure, under a magnifying power of 300–400 diameters. The blue-purple or purple-black color which appears in the investigation of some *Pezizas*, appears to be specifically characteristic. Thus *Peziza melaloma* A. S., no reaction. *P. badia* P., summits of asci pale blue. *P. repanda* Wahl., apices of asci blue. *P. trechispora* B. and Br., tips of paraphyses deep purple-blue. *P. vitellina* Pers., tips of paraphyses deep purple-black.

It may be worthy of note that owing to the blue color obtained in 1858, by Mr. F. Curry, in the examination of a species of *Tuber*, the name *Amylocarpus* was given as a generic appellation.

A NEW FLY-TRAP.— Professor A. Braun, in a communication to a Botanical Society, has briefly described a new form of vegetable fly-trap. (Botan. Zeitung, Sept. 20, 1872). The plant referred to is an East Indian Papilionacea, *Desmodium triquetrum* DC.

The simple leaf with a margined petiole feels rough to the touch, and remains hanging lightly to the finger which has touched it. Little flies, which alight on the leaf, are held by an invisible power and die after ineffectual struggles to free themselves from it. One can often see six or eight flies fastened in this way to the upper surface of the blade; less often, and more widely scattered, on the underside. The hairs which act thus are distributed over the whole surface and appear to the naked eye as scarcely noticeable white points: they are not over 0·08–0·10 millimetres long, and 0·01 millimetres thick, and consist of two cells. The under cell is one-fourth of the whole length. The upper cell is pointed like a fish-hook with a sharp barb. These acute angles, invisible without a lens, are what fasten the insect down.

Beside the angled hairs there are others on the leaf. They are found especially on the nerves, and have a much more appreciable length and thickness (0·50 and 0·01 millimetres), they are unicellular, blunt, and on the upper surface beset with little projections.

ZOOLOGY.

A FOUR-LEGGED ROCK LARK.— On November 23rd, while walking on the seashore in the vicinity of Plymouth, I saw the most

extraordinary *lusus naturæ* in the shape of a rock lark (*Anthus petrosus*) that I ever saw in my life. It had four legs and no tail (at least where the tail should have been), but that appendage was placed just above the left eye, and sticking out behind like a long depressed crest, — indeed it was a perfect "nightmare" of a bird, such a one as you might dream about — the extra legs were dangling from the extremity of its body. It was feeding on a heap of decayed seaweed on the shore. Unfortunately, I had no gun with me or I could have shot it a hundred times over, but as I had a field glass with me I could examine it as distinctly as though I had had it in my hand. The next day I returned to the spot with my gun and had a shot at it at once, but the gun "hanging fire" I did not quite kill it, and some children running to the spot before I could load again, it managed to flit away where I could not see it.

A "lusus" is not so wonderful in a bird just hatched, but seldom lives long, whereas this was a lively full-grown rock lark.— J. GATCOMBE, *Plymouth, England.*

BIRTHS OF ANIMALS IN THE CENTRAL PARK MENAGERIE.—Puma (*Felis concolor*). Two cubs were born August 24, 1872; period of gestation, thirteen weeks; spotted; born blind, eyes open on the eighth day; very playful. The puma has seldom more than two at a birth.

Leopard (*Felis leopardus*). Two cubs were born October 28, 1872; period of gestation, thirteen weeks; markings similar to that of the mother; born blind, eyes open on the eighth day.

Spotted Hyæna (*Hyæna crocuta*). Two cubs were born, one January 5, 1873, the other twenty-four hours after; covered with a soft hair half an inch long, of a uniformly black color, no indication of spots; born with eyes open. Weight of cub, 3¼ pounds, length from nose to tip of tail 22½ inches; tail slender and tapering; height at shoulder 9 inches; canines $\frac{2}{2}$, incisors $\frac{6}{6}$; conch of ears lying flat to the head; bald internally, outside covered with hair. Supposed to be the first hyæna bred in this country.

Camel (*Camelus dromedarius*). One calf was born January 16, 1873; period of gestation, twelve months, in this case twelve and a half months. About three hours after birth the calf was held up to suckle, the next day was able to get on its feet and nurse itself. — N. A. CONKLIN, *Director Central Park Menagerie.*

CANARIES AND HYACINTHS.—A lady visitor remarked that one

of our canaries had a bad cold, her quick ear having detected a wheezing sound like that of a catarrh. It had continued already for several days. Being myself very unpleasantly affected by the odor of some flowers, I guessed the cause to be the contiguity of the hyacinths growing in glasses, and now filling the room with perfume. These flowers, which were close to the cage of the sick bird, were now taken from the room and the bird showed immediate relief, and in a day was well.— S. LOCKWOOD, *February* 14.

PHOSPHORESCENCE. — Professor Panceri, of the University of Naples, has just published a memoir on this highly interesting subject, in the fifth volume of the *Atti della Reale Accademia delle Scienze fisiche e matematiche*, 1871, under the title "Gli Organi luminosi e la Luce delle Pennatule." It consists of two parts, one anatomical, the other physiological. He notes the existence of special organs which have the power and apparently the function of producing phosphorescent light, and finds that the light is only emitted by the polyps and the zooids, while the phosphorescent organs, as he terms them, consist of eight "cordoni luminosi," which are attached to the outside of the stomach of the polyps and zooids, and are prolonged in each case as far as their mouth-papillæ. These threads (cordoni) are principally composed of a tissue built up of vesicles or cells and possessing all the characters of fat; albuminoid cells are likewise met with in it. This fatty matter generates light, not only by the direct excitation of the polyps and the zooids themselves, but by excitation of the whole trunk of the Pennatula. In the latter case the author has made the remarkable discovery that the progress of the light developed in succession over the several parts of a polyp gave a striking indication of the direction, progress, and rapidity of the excitation applied to the Pennatula, and he has found these latter calculable, a fact of the greatest interest to physiologists. Professor Panceri further states that the phosphorescent substance produces light, after its removal from the body of the polyp, if subjected to mechanical treatment such as friction and compression, or the action of chemical agents, electricity or heat. And this is the case when the substance is extracted, not only from the living animal, but some short time after its death. The author, in his earlier investigations of the phosphorescence of other fatty

substances, considered the phenomenon due to their slow oxydation. He believes this holds good in the case of the "cordoni luminosi" of the Pennatula, and thinks it to a certain amount subject to the voluntary powers of the animal. He found similar phosphorescent substances in the epithelium of Medusae, and in Pholas he saw two distinct organs inside the mantle which are furnished with the power of becoming luminous. Some Chætopteri, Beroe and Pyrosoma were likewise examined, and a great similarity noticed in all these cases as regards the constitution of the phosphorescent substance. In the spectroscope the light exhibits one broad band like that given by monochromatic light, while, as is well known the phosphorescent light of *Lampyris* and *Luciola* is polychromatic.— *The Academy.*

THE GAME BIRDS OF THE NORTHWEST.—The game birds of the northwest seem in a fair way to be thoroughly looked up. We notice a circular from Dr. Coues, published by command of General Terry, of the Department of Dakota, inviting the coöperation of all army officers serving in the Department, in the work of ascertaining the precise geographical distribution of feathered game, their times of arrival and departure, breeding resorts, habits, etc. This is to be incorporated in a report on the "Ornithology of the Northwest," to be published by the Department of the Interior, and forming one of the series issued by the U. S. Geological Survey of the Territories, in charge of Dr. F. V. Hayden. The undersigned respectfully solicits the coöperation of those of his brother officers who may be interested in a certain portion of his work.

With their friendly assistance, he hopes to largely increase, and render more precise, our present knowledge of the *Game Birds* inhabiting the region drained by the Missouri river and its tributaries. Under this head are included:

1. *Grouse* of several different species: the sharp-tailed grouse, or "chicken;" the pinnated grouse, or prairie-hen; the ruffed grouse, or "partridge;" the dusky or "mountain" grouse; the ptarmigan, or "snow" grouse; the sage-cock, cock-of-the-plains, and the quail.

2. *Wading Birds* of various kinds: wood-cock, snipe, plover, curlew and allied species.

3. *Water Fowls* of all sorts: swans, geese and ducks.

He desires to ascertain, with entire precision, the geographical

distribution of the resident species, the times of arrival and departure of the migrants, and the localities to which the summer visitants resort to breed.

It is hardly necessary to add, that each contribution to the forthcoming report would be accredited to its proper source. In order to be available for the object in view, manuscripts should be received not later than June next.—*Address* Dr. E. Coues, U. S. A., *Fort Randall, Dakota Territory.*

GEOLOGY.

On the Tusk of Loxolophodon cornutus.—Professor Marsh asserts that I have reversed the positions of the tusks of this species, placing that of the left side on the right, etc. This statement is not true, as I have carefully distinguished the sides in my description (Short-footed Ungulata, etc., p. 10). In my plate 2d the inner side is not represented as the outer, as the inner surfaces of attrition are omitted, and the external represented. Like his other charges this one results from a misapprehension. Having seen a photograph in which, for the assistance of the artist, the left tusk was taken on the right side, he at once concludes that my lithograph represents it in the same position.— E. D. Cope.

ANTHROPOLOGY.

Existence of Man in the Miocene.— I have received a letter from Mr. Edmund Calvert, in which he informs me that his brother, Mr. Frank Calvert, has recently discovered, near the Dardanelles, what he regards as conclusive evidence of the existence of man during the Miocene period. Mr. Calvert had previously sent me some drawings of bones and shells from the strata in question, which Mr. Busk and Mr. Gwyn Jeffreys were good enough to examine for me. He has now met with a fragment of a bone, probably belonging either to the Dinotherium or a Mastodon, on the convex side of which is engraved a representation of a horned quadruped, "with arched neck, lozenge-shaped chest, long body, straight fore legs and broad feet." There are also, he says, traces of seven or eight other figures, which, however, are nearly obliterated. He informs me that in the same stratum he has also found a flint flake, and several bones broken as if for the extraction of marrow.

This discovery would not only prove the existence of man in Miocene times, but of man who had already made some progress, at least, in art. Mr. Calvert assures me that he feels no doubt whatever as to the geological age of the stratum from which these specimens were obtained.

Of course I am not in a position myself to express any opinion on the subject; but I am sure that the statements of so competent an observer as Mr. Calvert will interest your readers.—SIR JOHN LUBBOCK, *in* "*Nature.*"

MICROSCOPY.

AMPHIPLEURA PELLUCIDA IN DOTS. — A $\frac{1}{50}$ objective was made by Tolles to my order and finished on the 12th of March, 1873. The angle of aperture as invoiced by Mr. Stodder is 165°. From my measurements I think the objective is correctly named by the maker. At the extreme open point it is a good $\frac{1}{40}$ dry. The screw-collar has twelve divisions: by turning it eight divisions it is adjusted for uncovered wet, and four divisions remain to adjust for cover for immersion work. It works through covering glass of about $\frac{1}{200}$ of an inch; but it is better to use thinner glass, or mica, to enable the observer to focus through specimens.

With lamplight and the $\frac{1}{50}$ the resolution of *Amphipleura pellucida* is better than I have before seen. Using ordinary daylight *Vibriones*, *Bacteria*, etc., are well defined, especially when a Kelner eye-piece is used as a condenser.

With sunlight and the ammonia-sulphate of copper cell, *Surirella gemma* yields longitudinal striæ, and, as the direction of the light is changed, rows of "hemispherical bosses" as described by Dr. Woodward.

With the same illumination specimens of *Amphipleura pellucida*, mounted dry, by Norman, were resolved and counted with perfect ease and remarkable plainness, the striæ being still distinctly visible with No. 3 eye-piece, draw-tube extended six inches and powe upwards of 10,000 times. It is with hesitation that I remark fu ther that the $\frac{1}{50}$ has resolved the lines of *Amphipleura pelluci* into rows of dots, for the "beaded" structure of the easier te *Surirella gemma*, is still doubted by some experienced microsc ists. But facts are stubborn things, and the facts are that w Wenham's parabola as an illuminator the dots are seen, and either the paraboloid or the Amici prism longitudinal lines n

finer than the transverse ones are brought out. These lines, which I consider genuine, count not far from 120,000 to the inch. With a slight change of the adjustment their place is occupied by spurious lines counting generally about 60,000 to the inch. The longitudinal lines can only be seen when the focus is best adjusted for the transverse striæ. When the transverse lines are examined, they may be shown smooth and shining, similar to the photograph by Dr. Woodward in the NATURALIST, but much better. If the mirror is then carefully touched a sinuate appearance of the margins of the lines, suggestive of beading, is seen. This appearance can be brought out readily. And, finally, after the most painstaking manipulation, and when without doubt the best work is being done, the separated dots or beads appear.—G. W. MOREHOUSE.

NOTES.

ON the 21st of April Mr. Anderson formally presented the island of Penekese, together with a fund of $50,000 for the endowment of a School of Natural History. The board of trustees of the school and fund is in part the same as that governing the Museum of Comparative Zoology at Cambridge, of which this school is to be the educational branch. Plans have been drawn for two two-story buildings, each one hundred feet long and twenty-five feet wide. The lower floors are intended for laboratories and working rooms. The second story will contain sleeping rooms, and rooms for the preservation of specimens. The deed makes Professor Agassiz president of the board of trustees and director of the school, with the sole control of the method of instruction, and the appointment of teachers. The school will be called "The Anderson School of Natural History," and will be opened early in July.

FROM want of space we have been unable to adequately notice the remarks made at the banquet lately given in New York to Professor Tyndall just before he sailed for England. Many of the leading scientists of the country, with those eminent in all professions in New York, met him at Delmonico's. Perhaps this is the first occasion of the sort when in this country science has, through her followers and through those engaged in quite different pursuits, received due consideration. The after dinner speeches, with one or two exceptions, were animated with the true spirit of devotion to truth, which is but another term for the scientific spirit.

The burden of Professor Tyndall's admirable and delightful speech was the importance of producing trained original investigators. He had alluded to this before in his sixth and concluding lecture, where he says,—

"When analysed, what are industrial America and industrial England? If you can tolerate freedom of speech on my part, I will answer this question by an illustration. Strip a strong arm, and regard the knotted muscles when the hand is clinched and the arm bent. Is this exhibition of energy the work of the muscles alone? By no means. The muscle is the channel of an influence, without which it would be as powerless as a lump of plastic dough. It is the delicate unseen nerve that unlocks the power of the muscle. And without those filaments of genius which have been shot like nerves through the body of society by the original discoverers, industrial America and industrial England would, I fear, be very much in the condition of that plastic dough. At the present time there is a cry in England for technical education, and it is the expression of a true national want; but there is no outcry for original investigation. Still without this, as surely as the stream dwindles when the spring dries, so surely will their technical education lose all force of growth, all power of reproduction. Our great investigators have given us sufficient work for a time; but if their spirit die out, we shall find ourselves eventually in the condition of those Chinese mentioned by De Tocqueville, who having forgotten the scientific origin of what they did, were at length compelled to copy without variation the inventions of an ancestry who, wiser than themselves, had drawn their inspiration direct from Nature.

To keep society as regards science in healthy play, three classes of workers are necessary: Firstly, the investigator of natural truth, whose vocation it is to pursue that truth, and extend the field of discovery for the truth's own sake, and without any reference to practical ends. Secondly, the teacher of natural truth, whose vocation it is to give public diffusion to the knowledge already won by the discoverer. Thirdly, the applier of natural truth, whose vocation it is to make scientific knowledge available for the needs, comforts and luxuries of life. These three classes ought to coexist, and interact upon each other. Now, the popular notion of science, both in this country and in England, often relates, not to science strictly so called, but to the applications of science. Such applications, especially on this continent, are so astounding—they spread themselves so largely and umbrageously before the public eye—as to shut out from view those workers who are engaged in the profounder business of discovery."

After quoting De Tocqueville on the supposed unfavorable influence which republicanism has on the advance of science, Prof. Tyndall says:—

"It rests with you to prove whether these things are necessarily so, whether the highest scientific genius cannot find in the midst of you a tranquil home. I should be loth to gainsay so keen an observer and so profound a critical writer, but since my arrival in this country, I have been unable to see anything in the constitution of society to prevent any student with the root of the matter in him from bestowing the most steadfast devotion to pure science. If great scientific results are not achieved in America, it is not to the small agitations of society that I should be disposed to ascribe the defect, but to the fact that men among you who possess the genius for scientific inquiry are laden with duties of administration or tuition so heavy as to be utterly incompatible with the continuous or tranquil meditation which original investigation demands. I do not think this state of things likely to last. I have seen in America willingness on the part of individuals to devote their fortunes in the matter of education to the service of the commonwealth, for which I cannot find a parallel elsewhere.

This willingness of private men to devote fortunes to public purposes requires but wise direction to enable you to render null and void the prediction of De Tocqueville. Your most difficult problem will be not to build institutions, but to make men; not to form the body, but to find the spiritual embers which shall kindle within that body a living soul. You have scientific genius among you; not sown broadcast, believe me, but still scattered here and there. Take all unnecessary impediments out of its way. You have asked me to give these lectures, and I cannot turn them to better account than by asking you in turn to remember that the lecturer is usually the distributor of intellectual wealth amassed by better men. It is not as lecturers, but as discoverers, that you ought to employ your highest men. Keep your sympathetic eye upon the originator of knowledge. Give him the freedom necessary for his researches, not overloading him either with the duties of tuition or of administration, not demanding from him so called practical results — above all things, avoiding that question which ignorance so often addresses to genius: What is the use of your work? Let him make truth his object, however impracticable for the time being, that truth may appear. If you cast your bread thus upon the waters, then be assured it will return to you, though it may be after many days."

Again he enforces this idea in a practical way in his dinner speech: —

"To no other country is the cultivation of science in its highest forms of more importance than to yours. In no other country would it exert a more benign and elevating influence. What, then, is to be done toward so desirable a consummation? Here I think you must take counsel of your leading scientific men, and they are

not unlikely to recommend something of this kind. I think, as regards physical science, they are likely to assure you that it is not what I may call the statical element of buildings that you require so much as the dynamical element of brains. Making use as far as possible of existing institutions, let chairs be founded, sufficiently but not luxuriously endowed, which shall have original research for their main object and ambition. With such vital centres among you, all your establishments of education would feel their influence; without such centres even your primary instruction will never flourish as it ought. I would not, as a general rule, wholly sever tuition from investigation, but, as in the institution to which I belong, the one ought to be made subservient to the other. The Royal Institution gives lectures—indeed it lives in part by lectures, though mainly by the contributions of its members, and the bequests of its friends. But the main feature of its existence—a feature never lost sight of by its wise and honorable Board of Managers—is that it is a school of research and discovery. And though a by-law gives them the power to do so, for the twenty years during which I have been there no manager or member of the institution has ever interfered with my researches. It is this wise freedom, accompanied by a never-failing sympathy, extended to the great men who preceded me, that has given to the Royal Institution its imperishable renown."

Prof. Tyndall also announced in his speech, his intention of devoting the surplus of the money received from his lectures "to the education of young philosophers in Germany." We learn from Appleton's "Popular Science Monthly," that this surplus amounted to $13,000. This sum has been conveyed, by an article of trust, to the charge of a committee, of which Prof. Joseph Henry is chairman, and which is authorized to expend the interest in aid of students who devote themselves to original researches. This is certainly, the Journal adds, a noble example, and deserves to be emulated.

The eminent French naturalist Pouchet died Dec. 6, 1872, aged 73. He was the original advocate of the theory of spontaneous generation in its modern form.

We have been obliged to defer several reviews and miscellaneous articles until the next number, and beg the indulgence of our correspondents whose articles have been unavoidably crowded out for two or three months past.

We have also an important list of "Books Received," which we shall give in the next number.

THE

AMERICAN NATURALIST.

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SOME UNITED STATES BIRDS, NEW TO SCIENCE, AND OTHER THINGS ORNITHOLOGICAL.

BY DR. ELLIOTT COUES, U. S. A.

[*Based on manuscripts and collections of Lt. C. Bendire, U. S. A.*]

No sooner has the press closed upon the "Key to North American Birds" than I am called upon to add to our fauna two species hitherto unknown to inhabit this country, and believed to be undescribed. But since a new bird * has lately been discovered in Massachusetts, ransacked by ornithologists for half a century, it is not surprising that the comparatively untilled fields of the west should still yield novelties; and we may rest satisfied that North American ornithology will not crystallize till it has simmered for another generation or so. During the year just closed my esteemed correspondent has been diligently collecting near Tucson, Arizona, and has frequently favored me with interesting communications and specimens. Some of his earlier notes have already been published in this Magazine; † and now I have a few more I am equally pleased to offer. Besides the two species of

* *Passerculus princeps* Maynard, Am. Nat. vi, 637.—COUES, Key, 352.

† Relating to the discovery, in the United States, of *Glaucidium ferrugineum*, *Setophaga picta*, and *Tyrannus melancholicus* var. *Couchii*. Also, to the discovery of the nest and eggs of *Helminthophaga Luciæ*, *Harporhynchus crissalis*, and *Pyrocephalus rubineus* var. *Mexicanus*. In a communication dated Dec. 29, 1872, Lt. Bendire informs me of the capture, near Tucson, of *Scardafella squamosa* var. *Yncas*; a dove which, though already introduced to our fauna, has never before, to my knowledge, been taken within the limits of the United States.

birds, most of the nests and eggs to be noticed are new, at least to the public.

The Rufous-winged Sparrow* is a homely little bird, not particularly remarkable for anything I can discover, excepting the bright bay patch on the bend of the wing. It looks at first sight much like a field-sparrow (*Spizella pusilla*), that had curiously enough put on the wings of a bay-winged bunting (*Poœcetes gramineus*); but on sharper scrutiny is seen to be peculiar in other points besides. I suppose it goes in the genus *Peucœa*, and stands next to *P. ruficeps;* though, for that matter, our sparrows are split

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* PEUCÆA CARPALIS *Coues*, n. s. — Upper mandible turgid, its sides visible when the bill is viewed from below, its tomia inflected, the culmen slightly convex, running far on the forehead betwixt prominent antiæ; gonys quite straight. Wings a little shorter than the tail; 2nd to 5th primaries subequal and longest, 1st about equal to 7th; secondaries not surpassing 9th primary. Tail much rounded. Tarsus, measured in front, just shorter than middle toe and claw; lateral toes nearly equal to each other, their claw-tips falling a little short of the base of the middle claw, which the tip of the hind claw, when its digit is bent around, just reaches.

Entire crown rufous, or dull bay, only interrupted by a short pale median stripe on the forehead, and bounded by indistinct pale grayish superciliary stripes. Cervix like the crown, but mixed with gray. Scapulars and interscapulars grayish-brown, mixed with a little bay, and rather sharply streaked with blackish (thus much as in *Spizella socialis*); lower back and rump the same, but lacking the bay and blackish. Whole under parts soiled dull whitish, with faint brownish wash on sides, flanks and crissum, and entirely unmarked, excepting a short, sharp, black maxillary stripe on either side of the chin. All the lesser wing-coverts chestnut, very nearly as conspicuous as in *Poœcetes gramineus;* other coverts, and inner secondaries, with dark brown central field, and pale grayish-fulvous edging. Primaries and tail feathers dull dark brown with slight whitish edging. Bill apparently reddish flesh color, but most of the upper mandible dusky. Feet whitish-brown, the toes rather darker than the tarsus. Length (fresh) 6·00; extent 8·25. Length (dried); about 5·25; wing 2·50; tail 2·75, its graduation ·50; bill along culmen ·40; tarsus ·66; middle toe and claw ·70. (Inches and decimals.)

TYPE. No. 2689, Mus. E. C., since deposited in Mus. S. I.; Tucson, Ariz., Sept. 1872. (*Bendire.*) It is unmarked for sex, and in poor condition, preserved in the flesh with carbolic acid. The plumage likewise is much worn; in better state the colors may be brighter and purer than as described. Very young birds are probably streaked below, as in other young *Peucœa*, *Spizella*, etc.

This species does not resemble any other, with which I am acquainted, sufficiently to require comparison. Doubting lest it might be already described among its Mexican allies, I sent the specimen to the Smithsonian, where it was examined by Prof. Baird and Mr. Ridgway. The species may be instantly recognized by the chestnut flexure of the wing, as in *Poœcetes*, in combination with the particular size and proportions, as above given.

P. S., April 7, 1873.—Better specimens, since received, confirm the above surmise. The under parts are pure white, shaded on the sides and across the breast with clear pale ash, on the flanks and crissum with grayish-brown. The pure white chin is bounded by a sharp black line on either side, above which is another, less conspicuous, from the angle of the mouth. Crown and bend of wing alike rich chestnut. Quills and tail feathers blackish-brown, edged as above said, but tail feathers also slightly white-tipped. Markings of back, as described, sharp and pure. Greater wing coverts blackish, with light fulvous edging and whitish tipping. "Iris brown." Fresh, length 5·75; extent 7·80: ♂; taken Jan. 10, 1873.

into so many "genera" that nobody could sort them out if they were once mixed up; it is only by the peculiar process, known to ornithologists, and others, of calling a spade an agricultural implement, that they are perpetrated and perpetuated. Lt. Bendire says this sparrow is very common where he is, and that it stays there all the year; that he generally finds it in company with the black-throated finch (*Poospiza bilineata*), the habits of the two being much the same, and the nesting quite alike. The rufous-winged sparrow builds in a small mezquite or sage bush, often close to the ground and rarely over four feet from it. The nest is made of fine dry grasses and roots, with slender tops of "sacaton" (rye grass) and sometimes a few horse-hairs; it is quite deep, let down into a fork or crotch. The eggs are said to be almost exactly like those of the following bird, only a trifle larger, and four or five to a clutch, instead of three or four.

The Black-throated Sparrow (*Poospiza bilineata*) is a much prettier, jaunty-looking bird, with a jet black throat and face set off with pure white stripes. It is common on and near our south-western border. I frequently saw it in New Mexico and Arizona, at different seasons, but never found a nest, and do not know who was more fortunate until Lt. Bendire gathered quite a large lot. One of them now lying before me is composed of fine grass-stems mixed with much more of very soft-fibred inner bark of some plant I do not recognize, and lined with a little horse-hair. It is marked "Sept. 14th, 1872;" and I may as well mention here as elsewhere, that the laying season of several Arizona birds besides this one is protracted through September.* A set of eggs, taken August 25, numbers three; size, ·73 × ·58, ·74 × ·58, and ·72 × ·57, respectively. These are perfectly plain, white with a faint bluish cast; but occasionally — Lt. Bendire says about one set in twelve — the eggs are sparsely speckled with reddish. He continues: — "This bird is plentiful about here, and resident. It prefers higher ground, two hundred to five hundred yards from the creek bottom, though seldom further out on the plain. The nest is placed in a small mezquite, thorn or sage bush, seldom over four feet high, often almost on the ground. The clutch is usually three, rarely more. Two if not more broods are raised each season. I found fresh

*The following birds were still laying Sept. 13 — *Campylorhynchus brunneicapillus*, *Poospiza bilineata*, *Pipilo Abertii*, *P.* "*mesoleucus*," *Zenædura Carolinensis* and *Chamæpelia passerina*.

eggs Sept. 3. The usual note is *zib*, *zib*, *zib* and a twitter, something like the sound of a coin spinning on a table."

Abert's Towhee (*Pipilo Abertii*) and the Cañon Towhee (*Pipilo fuscus* of Swainson, not of Cassin: *P. mesoleucus* of Baird; Key, 152) are two large species related to our chewink, but dull colored (grayish, etc.) instead of black, white and chestnut. They inhabit the Colorado valley and its vicinity, though Abert's, at least, seems closely confined to the river itself and its tributaries. Both are abundant, and they live together; Abert's is the bigger, and the eggs are readily distinguished. A clutch of *P. Abertii* eggs containing three, taken September 4th, measure ·95 × ·78; ·94 × ·77; and ·95 × ·77; they are plump eggs, broad for their length, little smaller at one end than at the other. The color is bluish-white, sparsely marked, and chiefly at the larger end (where the markings form a splashed area, not a ring), with dark reddish-brown; some of the markings are very fine speckling, others are short, sharp zigzag lines; the general tone of the markings is very dark, as I have said, but some of the spots are quite light reddish, while others (in the shell, and consequently overlaid with its ground color) are neutral tint. The egg is decidedly peculiar, as compared with that of the other species, and recalls some of the least variegated samples of red-winged blackbird eggs, though still the markings are mostly spots, rather than streaks.—Two eggs of *P. fuscus*, taken Sept. 3, measure ·95 × ·72, and ·95 × ·70: thus being as long as those of *Abertii*, but very noticeably narrower, and more pointed at one end. The ground color is pale bluish; the whole surface is marked — thickly at the large end, where the spots tend to a ring, more sparsely elsewhere — with light brownish-red; a few of the (heaviest) spots are darker brown, and many others are neutral tint, or lavender. The marks range in size from mere points to moderately large spots; still they are all *spots*, none lengthening into lines, as is the case with those of *Abertii*.

The Ground Cuckoo (*Geococcyx Californianus*) is a large species of singular aspect and peculiar ways, noted for its swift-footedness, inhabiting the Southwestern Territories and California, and abundant in Southern Arizona. An egg of this bird that Lt. Bendire sent me, and the first one I remember to have seen, measures 1·55 × 1·25, being thus broadly ellipsoidal; the greatest diameter is near the middle, and hardly any difference in size of the two ends is appreciable. It is plain dull white, and looks something

like an owl's egg. My correspondent has noted, he says, a curious fact: — that several birds lay more eggs toward the close of the season than earlier, and he particularly instances the present species. He never found more than three eggs in April and May clutches; but four, five or six in July and August sets. He thinks it may be accounted for by the greater abundance of food after the midsummer rains.

The Painted Flycatcher (*Setophaga picta*) allied to our common redstart, is a beautiful black, white and carmine species which Lieut. Bendire has the credit of first finding in the United States (Am. Nat. vi, 436; Key, 110). Since last spring, when he secured and forwarded the first specimen, he has seen two others (Sept. 12); they were foraging for insects in a mezquite tree, and seemed to be on their way home to Mexico, from the mountainous part of Arizona, where, it is presumed, they passed the summer breeding.

The nest and breeding habits of the beautiful little Vermilion Flycatcher (*Pyrocephalus rubineus* var. *Mexicanus*) have lately been described in this Magazine by Lt. Bendire himself; but here I wish to notice another nest, since received from him. It was despoiled April 27, 1872. It is a low flat structure, which was saddled close down on a large horizontal fork, as I see by the impression of the boughs. Outside and underneath there are some quite large but light plant stems, two or three inches long; the substance of the nest is an inextricably mixed mass of very slender grass, fluffy inner bark, dried moss, horsehair, and white sewing-thread; the lining is a thick warm bed of large pigeon feathers— I think from the breast of a male Carolina dove. The nest is only about an inch deep, though it measures outside three inches across the brim; were it not for the few sticks, and some of the ragged strips, it might be called exquisitely light and delicate.

Nuttall's Whippoorwill (*Antrostomus Nuttallii*) is a beautiful and interesting species, abundant in many parts of the West, from the Missouri region into Mexico, replacing the common Eastern species (*A. vociferus*). It is smaller than the latter, and somewhat differently colored, with a nearly square instead of much rounded tail. It does not cry "whip′-poor-will" like our species, but drops a syllable, saying "whip′-poor" or "poor′-will" as the fancy of the hearer may interpret. But the most singular circumstance is, that it lays white or creamy-white eggs, entirely

unmarked — a thing before unknown in this genus. The eggs are two in number, laid in a mere shallow depression of the bare ground, usually at the foot of a bush — Lt. Bendire found them so, August 2, 1872. When he informed me of this I could not help thinking there was some mistake about it; but on communicating with Prof. Baird on the subject, he replied: "Nuttall's whippoorwill is unique in the genus for laying white eggs. We have several sets of them, and have established the fact beyond question." This is equally novel and interesting; but how about Dr. Sclater's generalization,* which I adopted without qualification in the Key (p. 180), to the effect that all the *Caprimulginæ* lay colored eggs? I think it is easier to stand corrected in this instance than to disturb the bird's position.

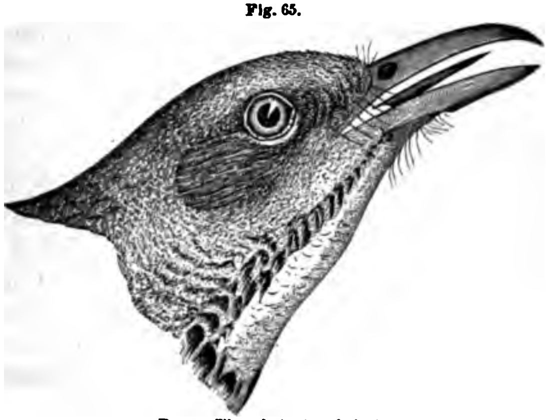
The presence of a sharp horny spur on the shank (tarsus) is a very common character of gallinaceous birds, well illustrated in the case of the barnyard cock; and in some birds of this order there are a pair of spurs, one above the other, on each leg. The turkey gobbler (*Meleagris gallopavo*) is well known to possess a pair, and this is supposed to be a constant character of the males of the genus *Meleagris*. Such, however, proves to be not always the case. "The males do not all have spurs; in fact, I thought at first that the variety of turkey we have in Arizona never had any, and I have been so informed by Mexicans and Indians. But I killed two gobblers myself a few days ago, and both were spurred; though the largest bird I ever killed, a male weighing twenty-eight pounds, had no spurs." (*In epist.*, Dec. 29, 1872).

Almost every one knows the Brown Thrush, or Thrasher (*Harporhynchus rufus*) of the Eastern United States — an abundant and familiar inhabitant of shrubbery, and a spirited songster, with some talent for mimicry. It belongs to the mocking-thrush group (*Miminæ*) all of which are famous for their vocal powers; the cat-bird, and the princely mocking-bird itself, are near relatives. The accompanying cut (Fig. 65) looks something like a thrasher in the act of singing. There is a Texan and Mexican variety of this bird, very similar, but longer billed, darker colored, and more heavily streaked underneath. The genus *Harporhynchus* (which means "bow-billed") contains several other species, equally interesting, and seeming to us the more remarkable on account of the extraordinary length and curvature of the bill. All these in-

* Proceedings of the Zoological Society, Feb. 1866, p. 127.

habit our southwestern border; they are much alike in color, differing from our rich foxy-red thrasher very nearly as the homely gray pipilos of the same region differ from the smartly-dressed chewink — being pale dull brownish or grayish, with few or no definite markings, except in one instance. Let us pass them in review, so as to be better able to judge of a certain new species I am going to describe. I will first mention the St. Lucas Thrush (*H. cinereus*); it agrees with the thrasher, and differs from all the rest, in being thickly speckled with brownish-black over most of the under parts. It is dull brownish-gray above; the shape of the bill is shown in figure 70, beyond. We shall have to look at this species again, presently. Next, we have the Californian Mocking-

Fig. 65.



Brown Thrush (natural size).

thrush (*H. redivivus.* Fig. 66). Its points are—the long arcuate bill; dark olive-brown color, paler below, gradually changing to rusty-brown on the belly and to rusty-white on the throat; heavily streaked ear coverts, but no maxillary stripes nor spots on the breast; length eleven inches or more, wing four or less, tail five or more, bill and tarsus, each, about 1¼ inches. This is the dark California coast form. In the arid Colorado river region, there is a variety of the same bird, identical in size, form and *pattern* of coloration, but extremely pale-colored, as if really bleached with the heat and dryness of the desert. It is apparently very rare; I never saw but two specimens, one of which I was fortunate enough to shoot myself, and only know of two others, which Dr. Cooper secured when he was at Fort Mojave. This is Leconte's

Mocking-thrush (*H. redivivus* var. *Lecontei*); I did not think it necessary to make a drawing of it, because an uncolored cut would show precisely like fig. 66. Next comes the Red-vented, or Crissal Thrush (*H. crissalis*); also inhabiting the Colorado and Gila valleys. It is fully as large as *redivivus* or var. *Lecontei*, with the tail even longer, and the bill, if not larger, at least slenderer and

Fig. 66.

Californian Mocking-thrush (natural size).

more arcuate, as shown in fig. 67. Although unspotted, and otherwise colored much like *redivivus*, it is immediately distinguished by having the under tail-coverts rich chestnut (like a cat-bird's — the contrast is quite as great), and by the presence of a sharp, black maxillary line bounding the definitely white throat. Lt. Bendire gave the first good biographical notice of this species

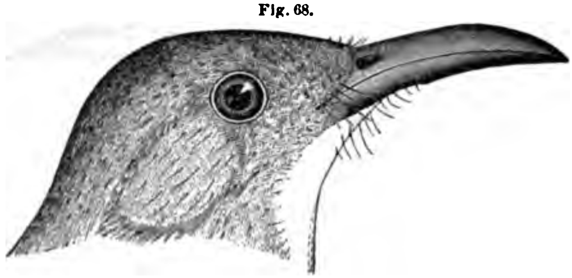
Fig. 67.

Crissal or Red-vented Mocking-thrush (natural size).

(Am. Nat. vi, 370); the eggs are 1·10 × ·80, large, emerald green. unmarked. Again, we have the Curved-billed Thrush (*H. curvirostris*) in which, notwithstanding its name, the bill is much *less* curved than in either of the last two; the shape is shown in fig. 68. This bird is about as large as *redivivus;* its peculiarities, aside from the bill, are, the duller coloration, pale fulvous. under tail-

coverts, no maxillary stripe (no markings whatever about the head excepting some vague speckling on the cheeks), and the under-parts obscurely marked with large dark gray spots on a pale gray ground, producing an appearance of clouding or marbling rather than speckling. The true *curvirostris* inhabits Mexico; the Arizona representative constitutes a variety (*Palmeri.* Fig. 68). I

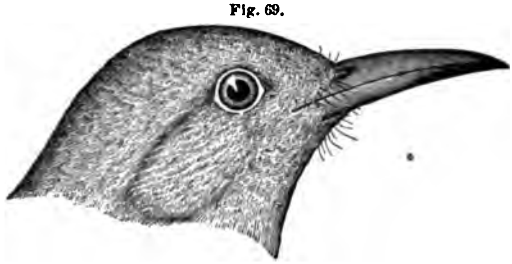
Fig. 68.



Palmer's variety of the Curved-billed Mocking-thrush (natural size).

described it accurately in the Key, p. 351, from Lt. Bendire's specimens, adopting Mr. Ridgway's then unpublished name, "*Palmeri.*" Its habits appear to be the same as those of *crissalis;* both birds build in cactus and other low bushes, and their eggs are of the same size. The egg of Palmer's thrush, however, is not like

Fig. 69.



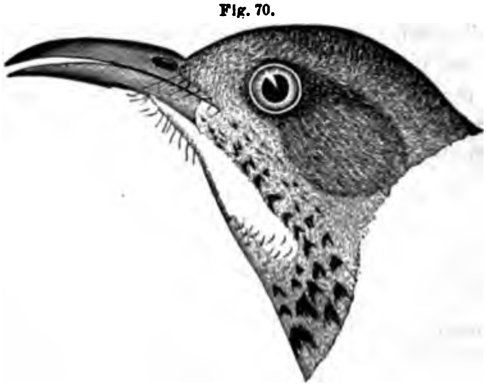
Bendire's Mocking-thrush (natural size).

that of the crissal thrush in color, being dull pale greenish, speckled evenly all over with brownish-red.

Besides all the foregoing, there is another kind of mocking thrush in Arizona, hitherto unknown to naturalists. Soon after I received my first specimens of var. *Palmeri*, Lt. Bendire sent me a bird I could not make out at all; and not having then specially studied these birds, I sent it to Mr. Ridgway, asking him to look over the Smithsonian series and see what it was. He promptly

returned the specimen, saying it was the *female* of his var. ***Palmeri.*** This puzzled me, for I knew of no such sexual differences in this genus as the specimen presented in comparison with var. ***Palmeri;*** but presuming, of course, that he knew his own species better than I did, I felt obliged to rest on what he told me, though I was dissatisfied, and in penning p. 351 of the Key, with the specimen before me, refrained from alluding to the (supposed) female of var. *Palmeri*, concluding to await developments. I wrote to Lt. Ben-

Fig. 70.



St. Lucas Mocking-thrush (natural size).

dire, who replied at once that the bird was an entirely distinct species, laying a very different egg, and having somewhat dissimilar habits; and he finally settled the case by sending me a male skin, precisely like the original female specimen, together with several of both sexes of var. *Palmeri*, all alike different from the new bird. A glance at figure 69, as compared with figure 68, will show that Bendire's Thrush,* as it may be appropriately named, has a very

* *Harporhynchus Bendirei* Coues, n. s. (Fig. 69.)—Bill shorter than head, comparatively stout at base, very acute at tip, the culmen quite convex, the gonys however only just appreciably concave. Tarsus a little longer than the middle toe and claw. Primaries:—3d and 4th about equal and longest, 5th and 6th successively slightly shorter, 2d equal to 7th, 1st equal to next to innermost secondary in the closed wing Tail little longer than the wings, moderately rounded. *Male*. Entire upper parts, including upper surfaces of wings and tail, uniform dull pale grayish-brown, with narrow, faintly rusty edgings of the wing coverts and inner quills, and equally obscure whitish tipping of the tail feathers. No maxillary nor auricular streaking; no markings about the head excepting some slight vague speckling on the cheeks. Under parts brownish-white, palest (nearly white) on the belly and throat, more decidedly rusty-brownish on the sides, flanks and crissum, the breast alone marked with numerous small arrow-head spots of the color of the back. Bill light colored at base below. Length about 9·25 inches; wing 4; tail 4·25, bill (chord of culmen) ·87; bill (along gape) 1·12; tarsus (in front) 1·25; middle toe and claw 1·12. *Female* not distinguishable from the male (the

differently shaped bill; and it is, besides, much smaller, and differently colored. The relationships of the new species are really with the St. Lucas thrush, rather than with Palmer's; for although the markings appear quite different, when we compare the sharp speckling of the under parts of *cinereus* with the faintly spotted breast of *Bendirei*, yet this difference might be produced by climatic influences, just as we have seen in the case of *Lecontei*. The size is the same; and it is the difference in the shape of the bill, in the relative lengths of the tarsus and toes, and in the wing-formula, rather than the coloration, that has caused my present decision, that *H. Bendirei* is not a desert race of *H. cinereus*.

Bendire's thrush is much rarer, in Arizona, than either the crissal or Palmer's. It is resident in the southern portion of the Territory. It builds preferably on trees, sometimes thirty feet high, instead of on bushes. The egg is only ·96 × ·70; its color, grayish-white, with spots and larger blotches, principally about the greater end, of two shades of pale reddish-brown, with some lilac and lavender.

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single specimen is rather smaller (wing 3·75 etc.) and still paler, duller brownish above; but this is owing to worn plumage, if not also, in part, to mummification with carbolic acid).

TYPES: ♂, no. 2687, mus. E. C.; Tucson, Ariz., Nov. 9, 1872. ♀, no. 2688, mus. E. C.; Tucson. Ariz., July 28, 1872. (*Bendire.*)

Allied to, and in some respects intermediate between, *H. curvirostris* var. *Palmeri*, and *H. cinereus*; coming nearest to the latter. Differs from var. *Palmeri* in being much smaller, with much shorter and differently shaped bill, different proportions of tarsus and toes, and markedly different coloration; the upper parts of var. *Palmeri* are a pure dark shade of grayish-brown with a tinge of olive, and the spots of the underparts are large, blended and diffuse, giving a marbled appearance. The average measurements of four specimens of both sexes, of var. *Palmeri*, are:—length 10·75; wing 4·33; tail 5; chord of culmen 1·12: tarsus 1·25; middle toe and claw rather more. In *H. cinereus*, of which a cut is herewith given (fig. 70), the bill, of about the same length as in *Bendirei*, is decidedly more curved; the tarsus is not longer than the middle toe; the 3d to 6th quills are subequal and longest, the 2nd being subequal to the 8th; and the under parts are as distinctly and heavily spotted as in *H. rufus* itself. The size is about as in *Bendirei*, and the coloration of the upper parts is much the same.

THE CONSERVATION AND CORRELATION OF VITAL FORCE.

BY J. T. ROTHROCK, M.D.

It is but lately that physicists have proven to the satisfaction of other men equally learned, that there does exist a series of compensations in the forces of nature; and that heat, light, motion and other powers, more or less unknown, not only may be converted, the one into the other, but that their exact equivalents may be stated in infallible mathematics. This had been dimly foreshadowed long ago, but its final proving belongs to our day. Vital force, however, from its very essence is more intractable, and overrides mathematical restrictions, willing (so far as we can now see) to acknowledge similar relations of the most general character only.

There is no denying that the most sublime mental endowments may in the same individual be associated with the most hopelessly ridiculous, and we are hence prepared to accept as true, or at least as not improbable, that the "greatest, wisest" of mankind could also be the "meanest." Indeed, second thoughts may convince us that surpassing intelligence in one direction, implying unbroken devotion to a given line of study, almost of necessity, entails a corresponding ignorance in other lines of mental activity for which no leisure hours can be found.

But whilst we are foiled in any attempt at estimating the exact amount of vital or purely mental force in excess in one direction, which it will require to compensate for a deficiency in some other, we may nevertheless, with some degree of certainty affirm that such relations do exist.

Geoffroy Saint-Hilaire not only recognizes the existence of this principle of compensation, but has drawn largely upon it in his teratological studies.

De Candolle, after granting the relation between excessive growth and atrophy, states that it is often exceedingly difficult to decide whether the former determines the latter, or the converse.*

* De Candolle, Theor. elem., ed. 1, § 73.

It is, then, with no claim to originality that this is written, but rather to call for the more general recognition of a law already noted by the more observing ones. We may be unable to explain it, or, what is still more damaging to its chances of acceptance, be unable to show how it is to chime in directly with any form of evolution; for to this we have all now come; still it remains a law, as active as any other, even though it be less sharply defined.

If called upon to express what I believe concerning it, I would say: that all organic things, plants or animals, have a certain proportionate amount of developing force, actual or predestined, and that this synergy is under the direction of inherited tendencies; which being at times misdirected, one organ or set of organs may take on excessive growth. Should this occur, there will be a corresponding atrophy in some other organ or set of organs. Now against this statement of what I conceive to be underlying all growth, many instances can be adduced. Still the facts in its favor, when fairly marshalled, seem to me so preponderating as to make them more than mere coincidences.

The scope of this paper allows me to cite but a few out of the many instances I could give. Among plants, take as an illustration *Larrea Mexicana* Moric., the creosote plant of the southwest. It is a representative of the bean-caper family. Inside the base of each filament (which is filiform) is a large two-cleft scale conspicuous enough to attract attention. It is not unusual to find filaments whose bases are not filiform, but are broadly expanded. *Erodium Texanum* Gray is a capital example of this. Besides, this same plant has an outer circle of five stamens which are minus their anthers, a fact which I might turn to account in my argument did space permit.

Now morphology would settle the question concerning the essential nature of the scales of Larrea, by saying that they are the homological equivalents of the stipules we usually find on the right and left sides of the petioles of leaves, and more or less intimately united with them, only in this case instead of being lateral they are intra-petiolar, *i.e.*, between the petiole and the axis of the plant, just as the stipules are occasionally found. To this explanation no exception can be taken, in so far as it goes. But the question still remains unanswered, why it is, when most plants have neither these scales nor the broad bases to their filaments, in the example I have just given, where a decided tendency to cell proliferation

exists, this proliferation should manifest itself in one direction only, *i.e.*, either as scales or broad bases to the filaments, but not both in the same plant?

Gaura, again, furnishes an example of the scales associated with slender filaments, and many more like cases could be brought forward. After some examination I am now unable to find a *distinct, unequivocal contradiction* to the principle I have enunciated. I am not prepared to affirm some do not exist. Indeed I should be surprised if they did not.

The typical anther of our conception is possessed of two cells. Sometimes, however, there is but one, which may often be explained by the partition wall being obliterated, and so causing the confluence of these usually separate cells. In Salvia (sage), however, there is but one cell where two might certainly have been expected. One has gone, entirely, or at most a mere knob of cellular tissue may remain to suggest the missing cell. Interposed between the perfect and the imperfect cells is a connective, unduly elongated, which from its very length and association with the separated halves of the anther serves to explain the want of development in the one. In other words the connective is vigorous and lusty at the expense of the impoverished cell.

Or take that illustration, almost too familiar to be alluded to here, the transformation of the stamens of the wild rose into the petals of the cultivated. It is a simple change of direction given to vital force, but, in so far as I can see, is no superadded power of development. Cultivation may turn the energies of the savage into a new channel, perhaps a higher one in some respects, but it does not follow that it is therefore, because higher in this sense, any indication of greater vitality or force of development. It is simply evidence of a transfer of power, and nothing more.

I have now in my possession an ear of Indian corn on which the grains have failed to develop, the chaff surrounding the grains being on the other hand enormously overgrown. If this instance stood alone I should be willing to admit that the failure of the grains to grow simply allowed room for their envelope to take on so unusual a size. I could, however, were I disposed, cite a long list of cases in which so mechanical an explanation would fail. I will quote a few, freely translated from Moquin-Tandon.

"M. Duval has observed flowers of verbascum, in which the filaments of the stamens took on an unusual growth, and at the

same time lost the usual hairs."* "In certain excessive developments of the parts of the vegetable the hairs abort incompletely, or entirely."† "Mr. Joseph de Caffarelli has given to me a somewhat dwarfed branch of bitter-sweet, which is covered with an enormous number of small hairs."‡ "In *Phleum Boehmeri* the inferior palet of the flower is dilated sometimes beyond measure; the edges then are soldered together at the base; at the same time the superior palet, and the pedicel of the rudimentary flower, abort entirely."§

"I have observed a monstrosity of *Faba vulgaris*, the stipules of which had taken on an enormous increase; they were changed into oval, foliaceous limbs, half arrow-shaped and slightly sinuous; at the same time the limbs of the ordinary leaves had disappeared entirely."‖

"In a monstrosity of *Muscari comosum*, all the flowers had aborted; at the same time the peduncles had become longer."¶

"Lately there has been communicated to the Société d' Agriculture de la Haute-Garonne a spike of corn which presented a curious example of this last balance; all the flowers were found in a normal condition except one, of which the calicinal envelopes had taken on a growth almost double their natural size; the surface of this flower was covered with a thick coat of hairs, and its appearance resembled much that of a flower of the "folle avoine."**

"In some flowers the atrophy of the stamens coincides with the hypertrophy of the pistils. For example, in certain individuals of *Lychhnis dioica* the male organs are found dilated, so that the pistils are represented by small, gland-like bodies; but in the other flowers the female organs are much developed, so that the stamens are reduced to simple rudiments; the same phenomenon occurs in *Spiræa Aruncus*, and in *Sedum Rhodiola*."†† In this last quotation we have plants associating themselves with such as our *Houstonia cærulea* in which, (belonging to hermaphrodite genera) there is a manifest tendency to assume that higher sexual organization where the individual shall be prepotently either male or female, as the one or the other set of organs takes on unusual growth. In other words, it seems to be a good illustration of the principle of vital compensation applied to function as well as to structure.

Mr. Thomas Meehan has furnished us a case directly in point

* Tératologie Végétale. p. 63. † *Idem*, pp. 62 and 63. ‡ *Idem*, p. 68. § *Idem*, p. 157.
‖ *Idem*, p. 156. ¶ *Idem*, p. 156. ** *Idem*, p. 158. †† *Idem*, p. 158.

in *Fragaria vesca* L. I quote him almost verbatim. "When it does not produce stolons, the number of flower spikes is increased, and, as they cannot run as stolons, they make up for this by continual axial production, bearing a succession of flowers through the whole season."

"Sometimes the runner party will so get the upper hand that the pistils will be entirely suppressed, in which case the runners push out with so much enthusiasm as to crowd down and frequently destroy their floriferous neighbors. In fact, just in proportion as the plant becomes truly fruit bearing, and with a tendency to produce a succession of fruit on the same stock, is the tendency to produce runners checked." He then gives a modification of the above, but which is still a case in point.*

The same journal contains a description of a double early saxifrage with a small *panicle*, *double flowers* and *no trace of either stamen or pistil*.†

The animal kingdom would furnish us with still more striking illustrations. A fact I had long suspected concerning hydrocephalic children met lately with a most unexpected confirmation in the distinct, unequivocal testimony of one of the most distinguished living pathologists. "The process of enlargement in these cases is often one of simple growth, and that indeed to a less extent than it may seem at first sight; for it is very rarely that the due thickness of the skull is attained while its bones are engaged in the extension of their superficial area. *Hence the weight of an hydrocephalic skull is not much, if at all, greater than that of a healthy one*; a large parietal bone, measuring nine inches diagonally, weighs only four ounces, while the weight of an ordinary parietal bone is about three ounces."‡

In his admirable text-book on "Diseases of Children," 2d edition, page 298, Dr. J. Lewis Smith under head of "Anencephalic Children," writes:—"The vault of the cranium is absent. There is a deficiency of the frontal, parietal and occipital bones, except those portions which are near the base of the cranium. These portions are very thick and closely united as if there were *the usual amount of* osseous substance, but instead of expanding into the arch, it had collected in an irregular mass at the base of the cranium."

*American Naturalist, August, 1869, pp. 328 and 329. † *Idem*, p. 327.

‡ Surgical Pathology, Paget, pp. 58 and 59. Third English edition.

Quoting again from the same author we are told:—"Hypertrophy of the brain is associated with rachitis, and stunted growth."* Under rachitis, he informs us that, "while in the first and second stages, there is an arrest of ossification and a deficiency of calcareous salts in the system, there is often in the third stage, as Lebert has stated, an exuberance of ossification and a superabundant deposit of the salts of lime; so that the reconstructed bone is stronger and firmer than the normal bone."†

Here then it would seem as though the compensation might extend over different intervals of time, one period being marked by a plus quantity, another by a minus:—a happy illustration of what John Hunter called the "body's memory." For this we are not entirely unprepared. The "stale" condition of overtrained pugilists is as much due, after all (some things lead us to suppose), to an excessive demand on their vitality as to subsequent dissipation; and the early break down of so many of our best college gymnasts is but another fact in the same category. Overdraw your bank deposit at one time and you are left a debtor at another.

Failure of the long bones to properly develop in their longitudinal direction under certain conditions of disease is connected with undue thickening of the same bone.

Turning now to the domain of surgery proper:—it is probable that the vast majority of new growths will be found to occur in advanced age, or at least after the "prime of life." I exclude ovarian tumors for manifest reasons.

So commonly do we find scirrhus tumors of the breast associated with declining years, that age is always made an element of the diagnosis. The testimony of Paget on this point is most explicit. His table of the frequency of cancer at the different periods of life is

Under 10 years	5
Between 10 and 20 years	6·9
" 20 " 30 "	21
" 30 " 40 "	48·5
" 40 " 50 "	100
" 50 " 60 "	113
" 60 " 70 "	107
" 70 " 80 "	126‡

* *Op. Cit.*, p. 374. † *Idem*, pp. 98 and 99. ‡ Third English Edition, p. 798.

thus showing that its frequency is more than twenty-five times as great between seventy and eighty years as at ten years of age.

Does it not seem as though the still unused strength, lacking in these declining years a legitimate employment, were engaging in the development of a low grade of cells whose vitality was insufficient for their own stability? This however is but a poor hypothesis to account for a well proved fact.

Be all this as it may, however, of this there is no doubt:—that after the removal of an *external*, malignant growth at an advanced stage of development, the chances of disease of the same character attacking an internal organ are greatly increased: hence prolongation of life is seldom gained by a surgical operation.*

Mr. John Simon gives an explanation of some of these facts I have derived from medical literature. I quote him, as they possibly may have a wider application. "But besides this antagonism effected through the general circulation, there probably are antagonisms of a local character; and parts which are respectively supplied by different contiguously-rising branches of one arterial trunk seem specially able thus to antagonize each other. For assuming the flow through an arterial trunk to remain the same, one branch, or set of branches can only transmit more blood, if, simultaneously, another branch or set of branches transmit less; and we may well conceive it to be an important function of vasi-motor nerves to provide for the adjustment of this antagonism, by establishing such inter-arterial sympathies that the relative opening of one branch shall determine the relative closure of another."† If not too mechanical and in contravention of vasi-motor function, I would venture to suggest that the relative *closure* of one branch might determine the *opening* of another, by forcing more blood through the latter. This would only account for those instances of the organic balance in which the plus and minus were in organs supplied from the same arterial trunk, *i.e.*, anatomical relatives. On the next page however the same author takes a more comprehensive view of his subject and says:—"Textural excitability perhaps is not so exclusively local but that in this respect also these may be conditions of inter-textural balance; the total excita-

*I am aware of the statistics of Velpeau regarding the removal of cancerous growths, but as they are so greatly at variance with the observation of the mass of surgeons, I do not regard them as invalidating my statements.

†Holmes' Surgery, 2d edition, Vol. I, p. 80.

bility of the body at any given moment being perhaps of fixed amount; so that with regard to excitement, just as with regard to blood-supply, plus in one organ would imply minus in another."*

I am unable to say just what views were entertained on this subject by Geoffroy Saint-Hilaire:—not having access to his writings. Milne-Edwards gives the following clear statement of his own opinion. "The principle of connection of organs regulating the place occupied by each; a tendency to an organic balancement, equipoise, or compensation when the development of an organ acts, as it were, injuriously upon others, as if the amount of vital force were restricted and limited.†"

Finally, I quote the following at second hand from Meckel. It seems almost too strange to be true, but as the authority is above reproach we can only accept it as a fact. Let it be observed that here, however, "this antithesis extends over different children of one and the same mother. A girl had on each extremity a superfluous digit, and one hand of her sister wanted four, being the number of digits which her sister had in excess, reckoning the four extremities together.‡"

These are a few out of the immense mass of similar illustrations I might bring forward in support of my belief in an absolute law at the bottom of these correlations of structure, and may I not add:—often of function?

There are many facts on the other hand, which seem to militate against it. But it appears to me most likely that as we more thoroughly understand the principles of biology, in the same measure will our exceedingly vague ideas on this subject become more determined and absolute:—in fact the evidence must almost of necessity, like that in favor of the theory of gravitation, become of a cumulative character. Any other supposition would imply a belief in the ancient idea of a *lusus naturæ*, which is opposed to the most firmly grounded dogmas of modern science.

Any decided deductions in the way of distinct propositions concerning this law are as yet premature, but the following may find some support in the cases I have already given:—

1st. That organs anatomically or physiologically related tend to compensate among themselves for any aberration of structure or function.

* *Idem*, p. 81.
† Manual of Zoology. Translated by R. Knox, edited by Blake, edition 1863, p. 200.
‡ Cyclopædia of Anatomy and Physiology, Vol. iv, part 2d. p. 946.

2nd. That an organ over-developed in one direction will be under-developed in some other: *e.g.*, the case of the long bones, already cited.

3rd. That time may be an element in this compensation: *i.e.* in rachitis deficient deposit of bony material may be followed later in the disease by an excessive deposit of it in the same bones.

4th. That the influence of this law may extend from one conception to another, as illustrated by the case related by Meckel.

THE GAME FALCONS OF NEW ENGLAND. THE PIGEON HAWK.

BY WM. WOOD, M.D.

This daring and spirited little hawk (*Falco columbarius*), which is peculiar to this continent, is found more or less common all over the United States and extends its migrations beyond the limits both north and south. Dr. Richardson says "it is not uncommon in 57° north latitude." Cassin says "it is found both on the Pacific and Atlantic coast and its locality may be stated as the whole of temperate North America." Audubon found them quite abundant in Texas "where he shot five in a short time." I am somewhat at a loss to know what interpretation to put upon the word abundant as used by Audubon. If it is received according to the common acceptation of the word, it is wholly at variance with my experience, and with that of my collectors, and of those with whom I exchange. The fact of shooting five in a short time proves nothing as to its abundance. They may all have belonged to one brood. Allen, in his ornithological notes on the birds of the Great Salt Lake valley, says that "the pigeon hawk and duck hawk were both frequent." This is I think the most that can be said of the abundance of this hawk anywhere. While it is not uncommon in some sections, in others it is very rare. Nuttall says, "It is, I believe, never seen in New England." For many years I believed that he was correct in this assertion, for, having used my gun quite frequently in Vermont, Massachusetts and Connecticut for twenty-three years prior to 1859, I had

never shot a single specimen; and furthermore, from 1847 to 1859, many, and probably most, of the hawks shot in this vicinity were brought to me, as it was known my museum was free to all, and consequently every one was interested to increase the number of specimens and enhance the attractions and value of my cabinet, and during this time not a single specimen of the pigeon hawk was brought to my office, although it was generally known that I was very anxious to obtain one. There were probably fifty or more specimens brought to me that the sportsmen called pigeon hawks, consisting mostly of Cooper's, sparrow, and sharp-shinned hawks, mostly the latter. Dr. Crary, of Hartford, who was several years my senior in collecting, had not shot or received a single specimen from New England prior to this time. With these facts before me I was prepared to endorse the assertion of Nuttall. The habits of some of our birds were not as well understood then as at present. We are now aware that oftentimes there is a lapse of several years between the times of visitation. Thus it has been with the pigeon hawk. In 1859 they were as common as any of our Rapacia. In 1860 they were less common, and since that time I have only occasionally received a specimen — one in 1871 and none the past season. They probably have left again for an indefinite period.

This bird when sitting on a tree so closely resembles a pigeon that it will oftentimes deceive the most expert hunter. One of the specimens brought me was shot for a pigeon, and the mistake was not discovered until the bird was picked up. It is from this striking similarity that I suppose it derives its name. Its flight is very rapid, and the daring spirit that it exhibits is not surpassed by any bird of its size, for it will not only attack birds larger than itself, but it has even been known to seize birds suspended in cages beside the house. When shot at and not wounded it will fly in circles over the head of the sportsman uttering short piercing shrieks. The little corporal hawk of Nuttall, and the *Falco temerarius* of Audubon, are one and the same bird, and are now considered by naturalists the adult of the pigeon hawk. At what age it arrives at adult plumage I am unable to say. It certainly is not the first year, and so far as is known to ornithologists it may take several years. It would seem from the testimony of Cassin to be at least three years. He says, "There are three well defined stages exhibited in a large number of specimens before

me." "Of these the adult is easily distinguished and is very nearly as figured by Audubon under the name of *Falco temerarius*, but of the other two plumages we cannot at present determine which is the more mature." This hawk is called by some the bullet hawk on account of its rapid flight. It is one of the most destructive of our rapacious birds. Says Samuels, "As he strikes his prey he almost always, instead of clutching it as it falls, alights after it has fallen, in the same manner as the great-footed hawk."

There seems to be some doubt about its nesting in New England or New York. Says Dr. Brewer, "I have inquired into the matter for the past forty years, and I have yet to know of the first instance of the nest and eggs of the pigeon hawk having ever been found in any part of Massachusetts. That it may breed in some mountainous and wild region is of course possible, and my inability to trace it is only negative testimony." Says G. A. Boardman of Maine, "I have never found the nest of the pigeon hawk, but have no doubt it breeds here, as I shoot it all summer and winter; it probably nests in some thick trees not easily seen. It is not a very common hawk with us." Says Samuels, "It is not improbable that it breeds in New England, although I do not remember of an authenticated instance." Says DeKay, "It is not uncommon in this state (New York). It does not so far as I have ascertained breed here." I have for thirty-six years used my gun in Vermont, Massachusetts and Connecticut, having resided in each of the above named States. I have followed the valley of the Connecticut river to its mouth — have followed the Green mountain range from Vermont into Connecticut without finding the nest of the pigeon hawk. For the last twenty years I have employed collectors in New England to gather birds and eggs for me, and have not received an egg of this bird. (The same can be said of my collectors in other parts of the United States.) Notwithstanding all this negative testimony I am of the opinion that they nest occasionally in New England; for in 1859 I received six specimens of this bird shot in May, June and August, and it seems improbable that six should remain here through the nesting season and not breed. In May, 1860, a gentleman who resides some five miles distant, informed me that a small hawk came almost every day and carried off a chicken for him — that it never missed, for it went so like lightning that there was no escaping its grasp. He said that

it always came in the same direction from a tract of woods near his house. Thinking from his description that it must be either the sharp-shinned, sparrow, or pigeon hawk, and believing that it must have a nest near, and wishing to obtain the eggs, I drove out. Accompanied by my friend, we carefully searched the woods without finding anything except the nest of the red-shouldered hawk. The next day the same little hawk returned and was shot, and is now in my collection, a beautiful representative of the pigeon hawk. I have no doubt that it had a nest about there, as it was the season for nesting, and it always came from, and went to the same piece of woods and in the same direction. If it had not young, it must have been carrying food to its mate while incubating. If a mere straggler, it would come and go without any definite place of resort. Our inability to find the nest was not strange, as there were some sixty or eighty acres of heavy-timbered oaks and pines in the tract.

There seems to be some diversity of opinion as to where they nest, as well as to the color and number of eggs. Hutchins informs us that it nests in hollow rocks and trees about Hudson's Bay — making its nest of sticks and lining it with feathers, and laying from two to four white eggs marked with red spots, while Audubon says "that in Labrador he found three nests placed on the top branches of the low fir trees, composed of sticks slightly lined with moss and feathers, and that each nest contained five eggs of a dull yellowish brown color thickly clouded with irregular blotches of dull dark reddish brown." He also found another nest with five young in it. Nuttall says "that it chiefly inhabits and rears its young in the southern states." Dr. Brewer says Nuttall is probably mistaken, as "The pigeon hawk is distributed in the breeding season throughout the northern part of North America. It breeds as far to the south as Maine on the Atlantic coast, and California on the Pacific." "In every instance when I have heard of the pigeon hawk as a summer resident south of Maine it has proved to be the sharp-shinned hawk (*Accipiter fuscus*)." And furthermore he says, in alluding to its nesting in hollow trees, "This is a condition in which the nest of the pigeon hawk is never found, and one in which no other hawk than the sparrow hawk is ever found." Dr. Abbott of New Jersey claims to have found a nest with young in it in a hollow sycamore tree near Trenton, in May, 1863, and to have found the nest with eggs on an elm tree in 1865. How are these differ-

ences to be reconciled? Further investigation alone can settle them. The egg in my cabinet was taken in Labrador and is well represented on plate first, figure first of Samuels' Ornithology. Long diameter $1\frac{9}{16}$; short diameter $1\frac{4}{16}$.

As I have only one egg, and as the number of specimens I have seen has been quite limited, I cannot speak authoritatively upon the subject. I will only say that the markings are almost exactly like those of the duck hawk described in my previous article on the game falcons of New England. They look like diminutive duck hawk's eggs.

In this as in all birds of prey, so far as I have investigated the subject, the female is the largest and most powerful bird. Female — length, 12 to 14 inches; alar extent, 24 to 27 inches. Male — length, 10 to 12 inches; alar extent, 23 to 25 inches.

The adult male is seldom taken here, perhaps one in twelve or fifteen specimens. As the description of the three stages of plumage is given so accurately by Mr. Cassin, and corresponds with my observations, I will give each stage as described by him.

Adult male. "Entire upper parts bluish slate color, every feather with a black longitudinal line; forehead and throat white, other under parts pale yellowish or reddish white; every feather with a longitudinal line of brownish black; tibiæ light ferruginous with lines of black. Quills black, tipped with ashy white; tail light bluish ashy, tipped with white and with a subterminal band of black, and with several other transverse narrower bands of black; inner webs nearly white; cere and legs yellow; bill blue.

Younger. Entire upper plumage dusky brown, quite light in some specimens, and with a tinge of ashy; head above with narrow stripes of dark brown and ferruginous, and in some specimens many irregular spots and edgings of the latter color on the other upper parts. Forehead and entire under parts dull white, the latter with longitudinal stripes of light brown; sides and flanks light brown, with pairs of circular spots of white; tibiæ dull white, with dashes of brown; tail pale brown, with about six transverse bands of white, cere and legs greenish yellow.

Young. Upper plumage brownish black, white of the forehead and under parts more deeply tinged with reddish yellow; dark stripes wider than in the preceding; sides and flanks with wide transverse bands of brownish black, and with circular spots of

yellowish white. Quills black; tail brownish black, tipped with white and with about four bands of white; cere and feet greenish yellow."

ON A SECOND EDITION OF THE GEOLOGICAL MAP OF THE WORLD.*

BY JULES MARCOU.

In 1859 I finished the manuscript of a geological map of the earth, which appeared two years after at Winterthur, Switzerland, in eight sheets, on a scale of $\frac{1}{23,000,000}$. The map, prepared by the learned geographer, my friend M. J. M. Ziegler, on Mercator's plan, although defective as regards certain details of execution resulting from my departure from Zurich to Boston, has, however, been received with favor by geologists as filling a desideratum in science. Some reductions and translations, with my consent, have been made in German, French and English.†

I have now just finished the manuscript of a second edition, intended to be placed in the International Exposition of Vienna, in May, 1873.

Not only have I carefully reviewed all the materials used in preparing the first edition; but also profited by numerous and important additions published during the past fourteen years, and have had in my hands a certain number of inedited geological maps and observations, which have been very liberally furnished by geologists who have explored and inhabited different countries remote and difficult of access. Let us pass in review very succinctly the more important of these new materials.

In the Arctic regions several expeditions have enabled us to color geologically a part of the islands of Spitzbergen, of Greenland, and to modify the geological age of the coal deposits of the islands of Disco, Prince Patrick and Bank's Land. M. Nordenskiold

* Read before the Boston Society of Natural History, March 19, 1873.

† From the negligence of Messrs. Oscar Fraas and Henry Woodward, my name has been omitted in the German and English editions of the reductions of my map. M. Fraas has apologized for it in a letter that he has written on the subject, while M. Henry Woodward, without any explanation, has contented himself with simply erasing my name from the block of the French edition which appears in "La Terre", by my friend Elisée Reclus.

has published at Stockholm a "Sketch of the Geology of Spitzbergen," where he recognizes the crystalline rocks, the Palæozoic, Carboniferous, Triassic, Jurassic and Tertiary. But the most unexpected discoveries, in latitudes so high, are those of terrestrial floras, dating at the miocene tertiary epoch, when, according to Professor O. Heer, all the northern polar region was covered with a vegetation analogous to that which to-day exists in the southern part of the temperate region of the northern hemisphere.

The geological survey of the kingdom of Norway directed by Prof. Kjerulf, besides some important modifications in the geographical distribution of rocks of the southern part of this country, has discovered a coal field of great interest from its geographical position, in one of the isles of the group of Loffoden, the island of Andö, as well as its geological age, which dates from the Jurassic epoch, as the coal bed of the coast of Yorkshire.

The great geological map of the entire Austro-Hungarian monarchy, published by M. F. R. von Hauer, has enabled us to rectify and to give more precision to the geology of the Eastern Alps, of Carpathia, of Dalmatia and Hungary. General Helmersen published at St. Petersburg, in 1863, a new edition of the geological map of Russia, based on that of Messrs. Murchison, Verneuil and Keyserling. But the most important modifications have been made in Russian geology by the researches of Messrs. Ludwig, Barbot de Marny, V. de Möller and Wagner, who have demonstrated the existence of an enormous Triassic formation, extending over a considerable extent of country, and which had been confounded and comprised by Sir Roderick Murchison and his collaborators with the Zechstein and Rothliegende, under the improper name of the Permian system. This question of the Russian "Dyas and Trias," raised by me in 1859, has received a definite and entire solution in the sense of my views, in the important work "Dyas" by Dr. H. B. Geinitz, Leipzig, 1862, and in "The Geological Map of the Western Slope of the Ural" by Valérien de Moller, St. Petersburg, 1869.

The geology of Egypt and Palestine has been especially modified by the researches of my friend Dr. Oscar Fraas, who has kindly sent me besides his journey entitled "To the Orient," a manuscript geological map of those regions. The English military expedition to Abyssinia has been of the greatest advantage to geology, and Mr. W. T. Blanford, of the Geological Survey of India, who accom-

panied the expedition, has published a geological map of the route traversed by the English army. For a long time geologists have disagreed as to the age of a great sandstone formation designated generally under the name "Nubian Sandstone," and in the first edition of the "Geological Map of the World," I have referred these sandstones to the New Red Sandstone (Dyas and Trias) by basing my conclusions on the lithology and on a piece of fossil wood found in Egypt, and described by Professor Unger. M. Louis Lartet, jr., after a journey in these regions, believed that he had discovered a complete and exact solution of the age of these sandstones; and in his work entitled "Essay on the Geology of Palestine, Egypt and Arabia," Paris, 1869, as also in a note inserted in the "Bulletin of the Geological Society of France," vol. xxv, p. 490, under the title of "On a Special Formation of Red Sandstones in Africa and Asia" he refers them not only to the Cretaceous formation, but even the horizon of the Gault and of the Glauconian chalk; and on a geological map he shows this formation extending from Lebanon, by Sinai, to the Cataracts of Assouan as far as Karthoum. Mr. Blanford has indicated these Nubian Sandstones, which he has named Adrigat Sandstone, under some fossiliferous limestones containing a Jurassic fauna and which he has named "Antalo Limestone," and he is led to regard the Nubian Sandstones as of the age of the New Red Sandstone (Dyas and Trias). As regards Sinai, two English observers, Messfs. Wilson and Holland have shown in these Nubian Sandstones the presence of some carboniferous fossils, or at least of fossils of the age of the Dyas. Thus the determination of the epoch of the New Red Sandstone for the Nubian Sandstone appears to be confirmed.

The geology of India has continued to be the object of very important researches on the part of Thos. Oldham and his assistants in the geological survey of this vast empire. My friend Mr. Oldham has kindly sent me a manuscript map which modifies greatly the results which I had accepted for the first edition of my map.

In China, we have had some data quite exact on several points, thanks to the researches of Messrs. Kingsmill, the Abbe David, Pumpelly and Bickmore. Professor E. Beyrich has published a work on the Island of Timor, and M. Jules Garnier has given a geological map of New Caledonia.

New Zealand, thanks to the researches of Messrs. Ferdinand Von

Hochstetter, Julius Haast and James Hector, is to-day completely known, and I owe to the kindness of the two last named *savants*, a manuscript geological map of these isles, which has just appeared at Wellington under the title of "Sketch Map of the Geology of New Zealand."

No country has made so much progress in geology during the last twelve years as Australia. The discovery and search for gold have certainly contributed to it, and the different colonies have devoted considerable sums towards sustaining geological surveys and mining statistics. The colony of Victoria especially has shown the example in the construction of a good geological map by Messrs. Selwyn, Brough Smyth, Ulrich, Henry Y. L. Brown, etc. From Tasmania I have received a manuscript map of all of Van Diemen's Land by Mr. Charles Gould, who for several years has directed the Geological Survey. In New South Wales the Rev. W. B. Clarke has given in numerous memoirs some excellent generalities on this part of the Australian Continent; and Mr. R. Daintree has just published a "Sketch Map of the Geology of Queensland" (Quart. Journ. of the Geol. Soc. of London, vol. xxviii, p. 271, 1872.) Finally, during these last two years Mr. Henry Y. L. Brown has made a geological reconnoissance of Western Australia.

Mr. Alfred Grandidier has given in grand outlines the general characters of the island of Madagascar, which appears to have almost nothing in common with South Africa, while it possesses great affinities with the geology of Western Australia, and even of New Zealand. Southern Africa has for several years, and especially since the discovery of the diamond mines, been the object of geological researches, which allow us to trace with considerable exactitude the principal lines of its geognostical constitution. The geological map of the colony of Natal has been published by Mr. C. L. Griesbach, and the great formation of the Karoo Sandstone, analogous to and probably identical with the Nubian Sandstone, has been studied with care by Messrs. G. W. Stow, G. Grey, Atherstone and Evans. Messrs. Jones and Huxley have coördinated and expressed general views on researches made on the same localities; and I owe to the friendship of Professor T. Rupert Jones a manuscript map reviewing all that has been done in this southern portion of the African continent.

In the New World Messrs. Musters and F. de Pourtalès have

discovered a group of extinct volcanoes between the River Gallegos, Cape Virgins and the eastern entrance of Magellan Straits, in Patagonia. Professor Burmeister, Director of the Museo Publico of Buenos Ayres, has sent me a manuscript geological map of the Argentine Republic, and Mr. David Forbes has published a new geological map of a part of Bolivia and Peru, which slightly modifies the most complete and detailed one of the late Alcide d' Orbigny.

In Brazil some great modifications and corrections have been introduced by the researches of Messrs. Hartt, Coutinho, Chandless and Orton, especially in the basin of the Amazons, and on the shore of the Atlantic Ocean. The Devonian and Carboniferous formations have been traced to Mont Ereré and to the first Cataract of the River Tapajos; the Cretaceous formation is found in upper Purus, and the Tertiary formation near Pebas on the River Marañon.

Mr. Charles B. Brown has sent me a manuscript geological map of English Guiana, the geological survey of which he has directed for several years. The same *savant* published several years ago, in collaboration with Mr. J. G. Sawkins, a detailed geological map of Jamaica.

Venezuela and the United States of Columbia, or New Granada, have been explored by Messrs. Rogias, Uricoechea and Dr. Maack, all of whom have very kindly communicated to me their interesting and difficult researches. The republics of San Salvador and of Guatemala have been explored by the late August Dollfus and M. E. de Montserrat, who have given a geological map of them. Finally, Baron F. von Gerolt, for a long time Prussian minister to Mexico, has published in New York a geological map of a part of the vast plateau, principally of volcanic origin, which extends between Puebla, Guerrero, Guanujuato and San Luis Potosi in Mexico.

The United States and the British Provinces of North America have continued to be the object of numerous researches and geological publications. I may signalize especially (1) in Hudson's Bay Territory the explorations of Messrs. J. Hector, Kennicott, Hind, Bell and Richardson; (2) the numerous journeys and studies of Dr. Hayden on the Upper Missouri; (3) the remarkable discoveries of Dr. Newberry in Arizona and New Mexico, of Messrs. C. King, Rémond de Corbineau, H. Engelmann, S. F.

Emmons, Marsh, Cope and Gilbert in California, Nevada, Utah, Wyoming, Colorado and Sonora.

I have preserved the same classification of rocks and the same colors, except for the pliocene formation, which I have taken out of the tertiary formation to place it with the quaternary and modern formations, with which it has more affinities.

TABLE OF COLORS AND EXPLANATION.

Pale Yellow.	Recent. Quaternary. Pliocene.	Modern Rocks.
Yellow.	Miocene. Eocene.	Tertiary Rocks.
Green, Cretaceous. Pale blue, Jurassic.		Secondary Rocks.
Brown Sienna.	Triassic. Dyassic.	New Red Sandstone Rocks.
Sepia.	Coal Measures. Mountain Limestone.	Carboniferous Rocks.
Prussian blue.	Old Red Sandstone. Silurian. Taconic.	Palæozoic Rocks or Grauwacke.

Pink — Crystalline Rocks.

Vermilion — Volcanic Rocks.

The classification of stratified rocks is merely provisional, and it is really accurate but only for the northern temperate zone, and even in that zone it is limited to the basins of the Atlantic Ocean and of the Mediterranean Sea. However, as we go from these limits, and as we arrive in India or on the Missouri and in California, then we encounter difficulties, that have been noticed and treated of quite plainly by most observers, which are obstacles which can not be passed over in silence nor yet avoided. For a stronger reason when we leave the north temperate zone, we find some anomalies and difficulties which, far from tending to be cleared up with time, on the contrary prove more and more the insufficiency of our classifications and the slight value of so-called palæontological laws. Let us cite some summary examples :—

In the Punjab, on the southern side of the Salt Range, near Jabi, Dr. William Waagen has just found some "Goniatites, Ceratites and Ammonites all together in a limestone bed of about one foot and a half in thickness, associated with unmistakable Producti, Athyris, etc." (See: On the Occurrence of Ammonites associated with Ceratites and Goniatites in the Carboniferous deposits of the Salt Range, "Mem. Geol. Surv. of India," vol. ix, art. 4. That is to say that there occur in the same beds, fossil

forms which in Central Europe indicate Carboniferous, Triassic and Jurassic formations.

In the Valley of the Missouri the forms of fossil Brachiopods, which in Europe characterize the Mountain Limestone, such as Producti, Athyris, Spirifer, etc., are found in some beds which contain at the same time some other fossils, of which the forms Allorisma, Solemia, Schizodus and Pleurophorus, indicate in Europe the Dyas (formerly improperly called Permian). Thus several geologists have ignored the existence of the Dyas in Nebraska, in Iowa, and in Illinois, and have sought to substitute for it a formation of passage that they name Dyaso or Permio-Carboniferous.

In California the forms of Tertiary and Cretaceous fossils are mixed together in such a way that some refer some groups of rocks to the Cretaceous formation, while others regard them as of the Tertiary epoch.

In Australia, some beds containing Carboniferous Brachiopods are found placed beneath and even alternately with coal containing a flora regarded in Yorkshire (England) as Jurassic. Finally in New Zealand, the formations called Secondary seem to be entirely obliterated; and it has been necessary to unite some rocks in the same groups under the bizarre name of upper Palæozoic or lower Secondary, ignorant to which of the two to refer them; and of the upper Secondary or lower Tertiary.

These examples show that our classifications and our laws are still imperfect, and also the progress there remains to be made in order to thoroughly know the history of the earth. The attempts at classifications of eruptive and stratified rocks; those, not less numerous, of the relative ages of interruptions in the deposits of stratified rocks; the study of the breaks and dislocations which have taken place on the surface of our planet, and of the relations which may exist between the one and the other, are all premature attempts, and of doubtful value. Having a knowledge, not even very profound, of some localities, theorizers have launched into the midst of generalities the value of which is very debatable even in the interests of geology. But as it is a quality of human nature of always wishing to theorize and to go from the particular to the general, and as we are always fond of simple explanations and *a priori* views, we easily fall into an admiration for all those who seem to unveil and render themselves masters of the secrets of

nature, and who expose them in certain brilliant mathematic laws, enhanced by the attraction of difficulties overcome, and of secrets unveiled. Vain efforts! They are only deceiving mirages. Ten, twenty, thirty years of observation dissipate them, and demonstrate their insufficiency and falsity. It is observation alone. Observe! Always observe! Do not leave a single corner of the globe without the minute observations of travelling and of resident geologists; and then we can generalize, and the mysteries of our planet will be unveiled and systematized in a synthesis, solid, logical with facts, well balanced and truly philosophical.

REVIEWS AND BOOK NOTICES.

GEOLOGY OF MONTANA.* — Full of interest as this volume is to naturalists and geologists, it also forms the most authentic account we have of the youngest of our territories; and as such, with its fully illustrated accounts of the hot springs and geysers of the Yellowstone and its tributaries, the graphic description of the wonders of the Yellowstone lake and falls, and of the Yellowstone National Park, together with the results of Messrs. Lesquereux and Cope's palæontological discoveries, will make the work excellent reading for any one not specially versed in science.

The White Mountain hot springs on Gardiner's River, will first engage our attention. They are not so numerous nor so wonderful as those of the Yellowstone valley or Fire Hole basin, but are much more accessible, and were, at the time the party surveyed them, frequented by a number of invalids, especially those suffering from cutaneous diseases. We quote Prof. Hayden's account.

"We pitched our camp at the foot of the principal mountain, by the side of the stream that contained the aggregated waters of the hot springs above, which, by the time they had reached our camp, were sufficiently cooled for our use. Before us was a hill 200 feet high, composed of the calcareous deposit of the hot springs, with a system of step-like terraces which would defy any description by words. The eye alone could convey any adequate conception to the mind. The steep sides of the hill were ornamented with a

*Preliminary Report of United States Survey of Montana and Portions of Adjacent Territories; being a Fifth Annual Report of Progress. By F. V. Hayden, U. S. Geologist, Washington, 1872. 8vo. pp. 538. With Maps and Illustrations.

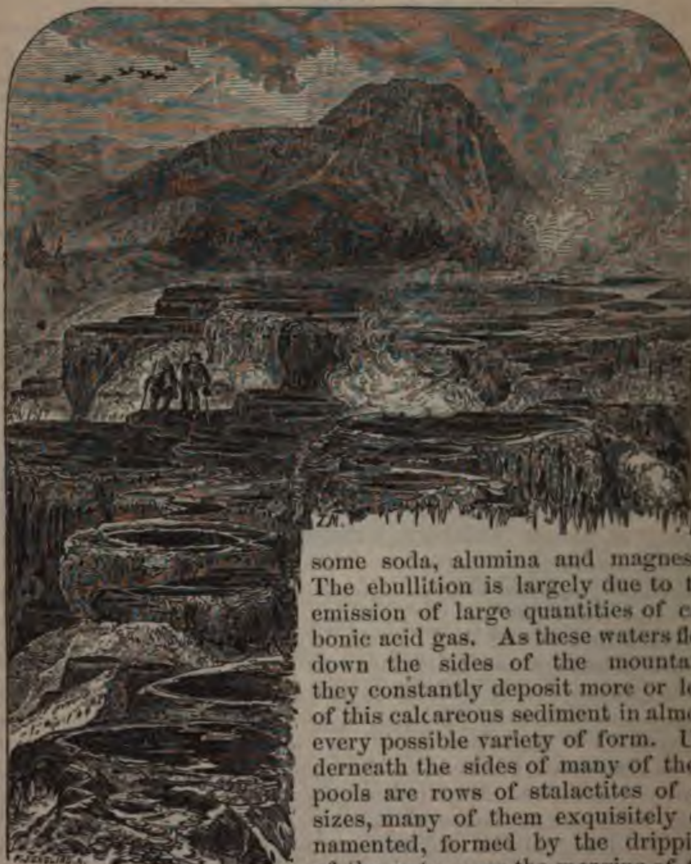
series of semicircular basins, with margins varying in height from a few inches to 6 or 8 feet, and so beautifully scalloped and adorned with a kind of bead-work that the beholder stands amazed at this marvel of nature's handiwork. Add to this, a snow-white ground, with every variety of shade, of scarlet, green, and yellow, as brilliant as the brightest of our aniline dyes. The pools or basins are of all sizes, from a few inches to 6 or 8 feet in diameter, and from 2 inches to 2 feet deep. As the water flows from the spring over the mountain side from one basin to another, it loses continually a portion of its heat, and the bather can find any desirable temperature. At the top of the hill there is a broad flat terrace covered more or less with these basins, one hundred and fifty to two hundred yards in diameter, and many of them going to decay. Here we find the largest, finest, and most active spring of the group at the present time. The largest spring is very near the outer margin of the terrace and is 25 by 40 feet in diameter, the water so perfectly transparent that one can look down into the beautiful ultramarine depth to the bottom of the basin. The sides o the basin are ornamented with coral-like forms, with a great variety of shades, from pure white to a bright cream-yellow, and the blue sky reflected in the transparent waters gives an azure tint to the whole which surpasses all art. The calcareous deposit around the rim is also most elegantly ornamented, but, like the icy covering of a pool, extends from the edge toward the centre, and this projects over the basin until it is not more than a fourth of an inch thick. These springs have one or more centres of ebullition, and in this group it is constant, seldom rising more than two to four inches above the surface. From varions portions of the rim the water flows out in moderate quantities over the sides of the hill. Whenever it gathers into a channel and flows quite swiftly, basins

Fig. 71.

Liberty Cap.

with sides from 2 to 8 feet high are formed, with the ornamented designs proportionately coarse, but when the water flows slowly, myriads of the little basins are formed, one below the other, with a kind of irregular system, as it might be called, which constitutes the difference between the works of nature and works of art. The water holds a great amount of lime in solution. It also contains

Fig. 72.



General View of Overflow of Great Spring, Gardiner's River.

some soda, alumina and magnesia. The ebullition is largely due to the emission of large quantities of carbonic acid gas. As these waters flow down the sides of the mountain, they constantly deposit more or less of this calcareous sediment in almost every possible variety of form. Underneath the sides of many of these pools are rows of stalactites of all sizes, many of them exquisitely ornamented, formed by the dripping of the water over the margins of the basins."

"Liberty Cap (Fig. 71) is undoubtedly," says our author, "the remains of an extinct geyser." The water was forced up with considerable power, and probably without intermission, building up its own crater until the pressure beneath was exhausted, and then it gradually closed itself over at

the summit and perished. No water flows from it at the present time." The above figure illustrates this chimney-like extinct geyser, of which large numbers were scattered over the surface "formed by what may be properly called pulsating geysers." Fig. 72 illustrates one of a series of bathing pools which is thus described.

"Between one of the largest oblong mounds and the base of the upper terrace, there is a kind of a valley-like interval, which has once been the centre of much activity, but at the present time there are numerous small jets from which the water is thrown to the height of 2 to 4 feet. But it is to the wonderful variety of exquisitely delicate colors that this picture owes the main part of its attractiveness. The little orifices from which the hot water issues are beautifully enamelled with the porcelain-like lining, and around the edges a layer of sulphur is precipitated. As the water flows along the valley, it lays down in its course a pavement more beautiful and elaborate in its adornment than art has ever yet conceived. The sulphur and the iron, with the green microscopic vegetation, tint the whole with an illumination of which no decoration-painter has ever dreamed. From the sides of the oblong mound, which is here from 30 to 50 feet high, the water has oozed out at different points, forming small groups of the semicircular, step-like basins."

We will then follow our party to the basin of the Yellowstone.

"The area of this basin is about forty miles in length. From the summit of Mount Washburn, a bird's-eye view of the entire basin may be obtained, with the mountains surrounding it on every side without any apparent break in the rim. This basin has been called by some travellers the vast crater of an ancient volcano. It is probable that during the Pliocene period the entire country drained by the sources of the Yellowstone and the Columbia was the scene of as great volcanic activity as that of any portion of the globe. It might be called one vast crater, made up of thousands of smaller volcanic vents and fissures, out of which the fluid interior of the earth, fragments of rock, and volcanic dust were poured in unlimited quantities. Hundreds of the nuclei or cores of these volcanic vents are now remaining, some of them rising to a height of 10,000 to 11,000 feet above the sea. Mounts Doane, Langford, Stevenson, and more than a hundred other peaks may be seen from any high point on either side of the basin, each of which formed a centre of effusion. Indeed, the hot springs and geysers of this region, at the present time, are nothing more than the closing stages of that wonderful period of volcanic action that began in Tertiary times. In other words, they are the escape-pipes or vents for those internal forces which once were so active, but are now continually dying out."

The celebrated Falls of the Yellowstone (Fig. 73) consist of two pitches, one 140 feet, and the other a quarter of a mile below, where the river plunges down a distance of 350 feet, into a cañon whose walls are 1200 to 1500 feet high, and "decorated with the

Fig. 73.

The Great Cañon and Lower Falls of the Yellowstone.

most beautiful colors that the human eye ever saw, with the rocks weathered into an almost unlimited variety of forms." . . . It is a sight far more beautiful, though not so grand or impressive as that of Niagara Falls.

"This entire basin was once the bed of a great lake, of which the lofty range of mountains now surrounding it formed the rim, and the present lake is only a remnant. During the period of the greatest volcanic activity this lake was in existence, though its limits, perhaps, could not now be easily defined; but it was at a later period inclosed within the rim. The basis rock is a very hard, compact basalt, not easily worn away by the elements. The surface is exceedingly irregular, and filling up these irregularities is a greater or less thickness of volcanic breccia and the deposits of hot springs. Upon all this, in some localities, continuing up to the time of the drainage of this lake, were deposited the modern volcanic clays, sands, sandstones, and pudding-stones, which reach an aggregate thickness of 800 to 1,000 feet. Above the Upper Falls the Yellowstone flows over a hard, basaltic bed for sixteen miles from its outlet at the lake; there is then an abrupt transition from the hard basalt to the more yielding breccia, so that the river easily carved out a channel through it; the vertical walls are clearly seen from below the falls, passing diagonally across the rim. The Lower Falls are formed in the same way; the entire mass of the water falls into a circular basin, which has been worn into the hard rock, so that the rebound is one of the magnificent features of the scene. Below the Lower Falls the sides of the cañon show the material of which it is mostly composed. Where the river has cut its channel through the hard basalt, the irregular fissures, which undoubtedly extend down, in some manner, toward the heated interior, are distinctly seen. Local deposits of silica, as white as snow, sometimes 400 or 500 feet in thickness, are seen on both sides of the Yellowstone. These also are worn into columns, which stand out boldly from the nearly vertical sides in a multiplicity of picturesque forms. The basis material of the old hot-spring deposits is silica, originally as white as snow, but very much of it is tinged with every possible shade of color, from the most brilliant scarlet to pink or rose color, from bright sulphur to the most delicate cream. There are portions of the day when these colors seem to be more vivid, and the rugged walls of the cañon stand out more in perspective, so that while the falls fill one with delight and admiration, the Grand Cañon surpasses all the others as the one unique wonder, without a parallel, probably, on our continent. We may conclude, therefore, from the point of view presented above, that while the cañon has somewhat the appearance of a great cleft or cañon, it is simply a channel carved by the river out of predeposited materials, after the drainage of the old lake-basin."

The Yellowstone lake is described in glowing terms. It is 22 miles long from north to south, averaging 10 or 15 miles in width from east to west, with a depth of 300 feet. "It is fed by the snows that fall upon the lofty ranges of mountains that surround

it on every side. The water of the lake has at all seasons nearly the temperature of cold spring-water." .

Happily this wonderful basin, or Yellowstone Park, has by Congress been set apart as a National Park, and thus its attractions will remain forever free to all, and we trust safe from injury by curiosity venders *et id omne genus.*

Before leaving Prof. Hayden's report we may call attention to the soda springs at the bend of Bear river, describing them in the words of the report.

"At the bend of Bear river is located the most interesting group of soda springs known on the continent. They occupy an area of about six square miles, though the number is not great. At this time they may be called simply remnants of former greatness. Numerous mounds of dead or dying springs are scattered everywhere, and only a few seem to be in active operation. So far as the manner of building up the calcareous mounds is concerned, it does not differ from that of the hot springs in the Yellowstone valley, and it may be that they were boiling springs at some period in the past. At the present time they are not usually much above the temperature of ordinary spring-water. In one or two instances the active springs were found to be lukewarm. Nearly all the springs were in a constant state of more or less agitation from the bubbles of gas that were ever escaping. In a few cases the water is thrown up 2 to 4 feet. One spring with a basin 10 feet in diameter, with the surface covered over with bubbling points from carbonic acid gas escaping, had a temperature of 61½°; another bubbling spring, 65°. The Bear river cross-cuts a number of the mounds, thus revealing the secret of their structure. The mounds vary from a few feet to twenty or thirty feet high, built up, in the same way as the hot spring cones, by overlapping layers. There are many of these mounds, which show, by the steepness of the sides, the amount of hydrostatic pressure. Many of the chimneys are nearly vertical, with the inner surface coated over with a sort of porcelain."

The second, third and fourth parts of the reports contain valuable contributions from Messrs. Thomas, Lesquereux, Cope, Leidy, Meek, Horn, Uhler, Edwards, Porter and Beaman.

Mr. Lesquereux gives the following summary of his views deduced from the study of our Tertiary and Cretaceous flora.

"1st. The Tertiary flora of North America is, by its types, intimately related to the Cretaceous flora of the same country.

2d. All the essential types of our present arborescent flora are already marked in the Cretaceous of our continent, and become

more distinct and more numerous in the Tertiary; therefore the origin of our actual flora is, like its *facies*, truly North American.

3d. Some types of the North American Tertiary and Cretaceous flora appear already in the same formations of Greenland, Spitzbergen, and Iceland; the derivation of these types is therefore apparently from the arctic regions.

4th. The relation of the North American Tertiary flora with that of the same formation of Europe is marked only for North American types, but does not exist at all for those which are not represented in the living flora of this continent. Therefore the European Tertiary flora partly originates from North American types, either directly from our continent or derived from the arctic regions.

5th. The relation of the Tertiary flora of Greenland and Spitzbergen with ours indicates, at the Tertiary and Cretaceous epochs, land connection of the northern islands with our continent.

6th. The species of plants common to the Cretaceous and Tertiary formations of the arctic regions and of our continent indicate, in the mean temperature influencing geographical distribution of vegetation, a difference, in +, equal to about 5° of latitude for the Tertiary and Cretaceous epochs.

7th. The same kind of observations on the geographical distribution of vegetable species shows at the Tertiary and Cretaceous times differences of temperature according to latitude, analogous to what is remarked at our time by the characters of the southern and northern vegetation."

We quote with much satisfaction the conclusions of so able a palæontologist as Mr. Lesquereux that the European Tertiary flora partly originated from arctic North America. We may be pardoned for referring to our own view expressed in 1865. From a study of the quaternary fossils of Labrador and New England, we ventured on general grounds, though not a botanist, to dissent from the view of Dr. J. D. Hooker, that the flora of northeastern arctic America was essentially Scandinavian in its origin.*

Dr. Horn discourses on the distribution of the Coleoptera collected on the plains of the Rocky Mountains and the mountains of Oregon and Montana. The species, owing to the variation in altitude, temperature, and the food plants, vary in a corresponding ratio. He remarks on this subject as follows:—

"*Eleodes obscura* Say affords a beautiful illustration of the extent to which this divergence may be carried. As a general rule I find, not only in *Eleodes*, but also in many other genera, that the

* Observations on the Glacial Phenomena of Labrador and Maine. Read Oct. 4, 1863. (Memoirs Boston Society of Natural History, 1867.)

higher the elevation or the colder the climate, the rougher and more deeply sculptured is the species. The smoother forms of *E. obscura* may therefore be expected in the southern regions in which it occurs; for example, var. *dispersa* is New Mexican, elytra with scarcely any traces of striæ; var. *obscura*, elytra distinctly sulcate, but not deeply, is from Colorado and Southern Idaho. As we advance to the west the elytra are more deeply sulcate, as in var. *arata*, while var. *sulcipennis*, from nearer the Pacific coast, has deeply sulcate elytra, with very convex interspaces. The same variation of sculpture occurs in *Calosoma luxatum* Say, which starts in Colorado with comparatively smooth elytra, until in Vancouver we find the elytra covered with lines of granular elevations, forming the variety known as *C. pimelioides* Walker. The two extremes of each series above noted appear to differ widely from each other, and to be entitled to rank as distinct species. In the foregoing remarks reference only has been made to variations within specific limits. The same law appears to hold between different species. In the genus *Omus* the most roughly sculptured species occurs in Washington Territory (*O. Dejeanii* Reiche), and the smoothest (*O. lævis* Horn) from near Visalia, California. The object of the preceding remarks is to explain what appears to be a law of variation for our western slope, and thus cause the unnecessary multiplication of species, founded on slight characters, to be avoided.

Species everywhere in our fauna appear to be distributed on lines of country presenting as nearly as possible similar meteorological conditions. Thus many Oregon forms extend southward into California, gradually seeking a higher mountain habitat as the region becomes warmer. Two species illustrate this — *Tragosoma Harrisii* and *Phryganophilus collaris*. Both extend their habitat from Maine to California, following the cooler regions westward from Maine through the Canadas and Red River region, thence northward nearly to Sitka. From the latter point southward to Oregon both occur at the ordinary level, and rising as a more southern region is reached, until at the latitude of Visalia they occur only a short distance below the snow-line, at an altitude of from ten to twelve thousand feet.

From Southern California species have extended along the desert regions bordering the Colorado river to Utah. Two instances are presented in the collection just examined—*Calosoma semilæve* and *Anisodactylus piceus*. Species advancing from the region just cited cannot be expected to cross the Rocky Mountains. Our common *Harpalus caliginosus* extends westward over all obstacles until the base of the Sierra Nevada is reached. It has not yet occurred in California proper."

The volume concludes with important papers on the Hemiptera by Mr. Uhler, and an extended essay on the Orthoptera by Prof. Thomas, illustrated by two plates.

RECENT CONTRIBUTIONS TO AMERICAN GEOGRAPHICAL ORNITHOLOGY. — We have before us several recent papers relating to the avian faunæ of a number of quite widely separated localities. To Messrs. Holden and Aiken we are indebted for "Notes on the Birds of Wyoming and Colorado Territories."* These notes were sent to Dr. T. M. Brewer for his private use, and by him communicated to the Boston Society of Natural History. From his introductory note we learn that Mr. Holden's observations were made "in summer," and Mr. Aiken's "between November 1, 1871, and May, 1872. The exact locality, however, is left in doubt, but we are led to infer from Mr. Holden's remarks which follow, that this gentleman's observations were made chiefly about Sherman "in the immediate vicinity of the Black Hills," near the boundary of Wyoming and Colorado Territories. Mr. Aiken's notes, as partially appears from his memoranda (and as I have learned from private sources), were made in El Paso County, Colorado (most of them near Fountain), some two hundred miles south of Sherman and about two thousand feet less in elevation. The two localities thus differ greatly in climatological and other general features affecting the distribution of species. The whole number of species given in the list is one hundred and forty, of which but twenty-seven are common to the two localities. Only fifteen are mentioned by Mr. Holden that are not noted by Mr. Aiken, while the latter reports ninety-eight that are not given by the former. The whole number mentioned as occurring in the vicinity of Sherman is hence forty-two, while one hundred and fourteen were observed near Fountain. The primary value of faunal lists consists, of course, in the indications they give as to the avian peculiarities of limited districts. It would hence have been far better, doubtless, not to have combined in a single list the notes made at such distant localities, and under such diverse topographical and climatic conditions. These observations, however, as thus given, are extremely interesting and very valuable, having evidently been carefully made. They are, moreover, from localities hitherto scarcely explored; the very imperfect recently published list of the birds of Cheyenne (some forty miles east of Sherman, on the Plains, and nearly two thousand feet lower) and the partial

*Notes on the Birds of Wyoming and Colorado Territories. By C. H. Holden, Jr.; with Additional Memoranda, by C. E. Aiken. Proc. Bost. Soc. Nat. Hist., Vol. XX, pp. 193–210; Dec. 1872. (Read June 5, 1872.)

lists of the birds of South Park and of the region at the base of the mountains between Denver and Colorado City,* being the only special reports relating to the birds of the region embraced within or contiguous to the districts explored by Messrs. Holden and Aiken.

The country about Sherman is one of the most barren and forbidding of any of the inhabited portions of the great central plateau of the continent, and the small number of species observed there by Mr. Holden fairly indicates its poverty, ornithologically considered. On the other hand, the region about Fountain, in the valley of the Upper Arkansas, is in a far milder and more fertile district, and the much larger number of species reported by Mr. Aiken indicates nearly its proportionately greater richness in avian life. Neither of these lists purports to be complete or exhaustive, yet they probably embrace all the more common and characteristic species of the two localities.

The whole number of names given is one hundred and forty-two, but in the foregoing remarks it has been considered safe to regard the *Troglodytes aëdon* of Holden's list and the *T. Parkmani* of Aiken's as identical, both undoubtedly referring to the same race (*T. aëdon*, var. *Parkmani*) of *T. aëdon* and not to two species, even if it be assumed that *T. Parkmani* and *T. aëdon* are specifically distinct. In like manner the *Scolecophagus ferrugineus* of Holden's list has been regarded as *S. cyanocephalus* of Aiken's, since the latter is a common summer resident far to the eastward of Sherman, while *S. ferrugineus* has not been previously reported from points nearer Sherman than Eastern Kansas. I have also learned that *Erismatura Dominica* should read *E. rubida.*

Mr. W. D. Scott has given a "Partial List of the Summer Birds of Kenawha County, West Virginia."† The list is based on "two months of field-work (from the middle of January till the middle of August, 1872)," and embraces eighty-six species. The accompanying notes indicate the relative abundance of the species observed, and embrace occasionally short notices of habits and descriptions of the first or nesting plumage of the young, in cases where such stages had not been previously well described.

The avian fauna of Kenawha County consists of a mixture of

* See Allen's "Ornithological Reconnoissance of Portions of Kansas, Colorado, Wyoming and Utah," Bull. Mus. Com. Zool., Vol. III, pp. 113-183, June, 1872.

† Proc. Bost. Soc. Nat. Hist. Vol. XV, pp. 219-228, Jan. 1873 (Read Oct. 2, 1872).

species more or less distinctive of the Alleghanian and Carolinian faunæ, representatives of the former prevailing in the highlands, and representatives of the latter in the valleys. The capture of a pair of *Dendrœca Dominica* is reported,—a species whose northern limit of distribution has generally been supposed to be the lowlands of the South Atlantic and Gulf States. Mr. Scott calls especial attention to the fact that certain species which range over a wide area in latitude differ appreciably in color at this locality from their representatives from more northern or southern localities, being more intensely colored than those from points to the northward, while they are less so than those found further south. *Thryothorus Ludovicianus* and *Ortyx Virginianus* are cited as strongly marked instances. As a faunal list, the paper affords valuable data concerning the summer distribution of the birds of the Atlantic States.

Mr. T. Martin Trippe has published "Notes on the Birds of Southern Iowa,"* based on "the author's observations during a period of nearly two years in Southern Iowa. . . . One year was spent in the southwestern part of Mahaska County; the other in the northeastern part of Decatur County, the latter point being fifty or sixty miles southwest of the former." Mr. Trippe states that although these localities are so near each other, and similar in their physical features, there are quite marked differences in their avian faunæ. In Mahaska County, for instance, the Warblers are much more abundant than in Decatur County, while several species were met with at the latter or more southern point that were not seen at the other. Among these are *Zonotrichia querula*, *Spizella pallida*, *Vireo Belli* and *Salpinctes obsoletus*, birds whose range is chiefly westward and southward. *Spizella pallida* is properly a bird of the plains, and *Salpinctes obsoletus* has not been previously reported much to the eastward of the Rocky Mountains. Several pages of remarks descriptive of the locality and its faunal peculiarities introduce the list, and add much to the value of the paper.

The list, though not presented as a complete one, is believed by its author to pretty fairly represent the main avian characteristics of the region in question. Of the one hundred and sixty-two species mentioned, ninety-two were observed breeding, or in such numbers during summer as to leave no doubt of their breeding

* Proc. Bost. Soc. Nat. Hist., Vol. XV, pp. 229, March, 1873 (Read Oct. 16, 1872).

there, eighty-five of them being regarded as common. Mr. Trippe calls attention to the fact that all but fifteen of the species he found breeding in abundance in Southern Iowa, breed also abundantly on the Atlantic coast, in the same latitude, nearly fifteen hundred miles to the eastward. This he considers as an astonishingly small difference, considering the great distance between the two points. Although perhaps surprising at first sight, when taken in connection with the fact of the considerable differences in the faunæ of localities separated by only two or three hundred miles in latitude, it finely illustrates certain general laws of geographical distribution, namely, that difference in longitude has *per se*, almost nothing to do with the limitation of habitat, while a slight difference in latitude, being necessarily accompanied by differences of temperature, is a powerful modifying cause. In other words, that species are limited in longitude by climatic and other differences in the conditions of environment resulting from the configuration of the general surface of the country, and not by distance merely. Mr. Trippe's list is accompanied with valuable notes relating to the season of occurrence and relative abundance of the species. — J. A. A.

New Avian Subclass.* — The recent discovery of *Ichthyornis dispar*, and *Apatornis celer*, is one ranking in interest, and importance with that of the *Archæopteryx;* an important gain to palæontology which, as Prof. Marsh observes, " does much to break down the old distinctions between Birds and Reptiles, which the *Archæopteryx* has so materially diminished." With just appreciations of the value of the characters presented, the writer proposes for the birds an order *Ichthyornithes*, and a subclass *Odontornithes*. The vertebræ were amphicœlian, and there were numerous, small, compressed, pointed teeth, distinctly socketed, in both jaws. If Prof. Marsh's surmise, that the *Archæopteryx* likewise had teeth and biconcave vertebræ, should prove true, a question of synonymy with *Saururæ* might arise. In explanation of the improper allocation of *Ichthyornis* (in the Key to North American Birds), among ordinary natatorial types, it should be stated that information of the discovery was received just as the pages were going to press, and in advance of Prof. Marsh's final determinations. — E. C.

* *On a New Subclass of Fossil Birds* (Odontornithes). By O. C. Marsh, "American Journal Science and Arts," v, Feb., 1873 (pub. Jan 21, 1873).

BOTANY.

COLORING AND DRYING OF NATURAL FLOWERS.—Mr. Muir gives the following abstract of this paper, by E. Puscher (Dingl. Polyt. J. ccv, 391–2.) The flowers are placed in a glass funnel, which is inverted over a plate containing a few drops of sal ammoniac solution. After a few minutes, most blue violet or bright carmine-colored flowers change to a Schweinfurt green; dark carmine flowers become black, white change to sulphur-yellow. The flowers plunged into fresh water retain their new colors for 2–6 hours, and then lose them. By a somewhat similar treatment with hydrochloric acid, many flowers, especially asters, may be colored a beautiful red, which is lasting after the flowers are carefully dried.

THE INFLUENCE OF COLORED LIGHT ON ASSIMILATION BY PLANTS. —E. Lommel (Pogg. Ann. cxlv, 442.) (Abstr. by E. Kinch.) enumerates many of the conclusions arrived at by different experimenters on this subject, and considers it a well-ascertained fact that the greatest amount of decomposition is produced by those rays which are absorbed by chlorophyll, and have at the same time a high mechanical intensity. Solid chlorophyll shows the absorption bands ii, iii, and iv, but very much less plainly than a solution of chlorophyll, because the white light which passes between the interstices of the chlorophyll cells usually forms a continuous spectrum over the absorption bands, and so dims or wholly obliterates the paler ones, whilst the band i suffers only a slight diminution in intensity. The theory of the author is supported by the direct experiments of N. J. C. Müller (Bot. Untersuchungen, Heidelb. 1871) and by the following experiment.

Two similar bean-plants were placed in frames, the sides and top of the first of which were composed of a combination of blue cobalt glass and red copper glass, which allowed only the red rays between A and B to pass through; in the second, a combination of red and violet glass was used, which transmitted only the middle red rays. Both conbinations were so dark that the plants could scarcely be seen from the outside; their power of transmitting heat rays was almost identical. At the end of a week, the first plant was sickly and had not increased in size, whilst the young leaves of the second plant had doubled in size, and it was not to

be distinguished from a similar plant kept in diffused daylight. This experiment shows that the middle red rays above can support the growth of a plant, whilst the outer red rays are unable; and also that assimilation is dependent on the quality of the rays and not on the intensity of the light.

W. Pfeffer (in Pogg. Ann. cxlviii, 86–99) interprets Lommel's experiments as only showing that more growth takes place under the influence of the middle red rays, than under that of the outer red rays.

An abstract of Prof. Draper's interesting experiments in the same field will be given in our next number.

MICROSCOPIC PHOTOGRAPHY OF VEGETABLE TISSUES.—Mr. Pedler makes the following synopsis of this sketch, by L. Erkmann. (Zeitsch. Anal. Chem. xi, 395.) The section of the plant or other tissue is to be placed, for a night, in a solution of aniline red, not too concentrated. On washing the tissues with water the non-nitrogenous tissues are left uncolored, whilst the nitrogenous tissues remain colored, there being also a considerable amount of shading. From a negative thus prepared, a positive may be obtained in which the nitrogenous substances are dark and the non-nitrogenous light.

EFFECT OF COAL-GAS UPON TREES AND SHRUBS.—A series of experiments was tried in Berlin in order to determine the amount of damage done to the roots of trees and shrubs by gas escaping from pipes through the soil, and thus coming in contact with them. It was found that even so small a quantity as twenty-five cubic feet per diem, distributed in one hundred and forty-four square feet of ground, and at the depth of four feet (that is, through five hundred and seventy-six cubic feet of earth), killed in a short time the rootlets of trees of every kind which came in contact with it, and that this damage was sooner done, the firmer and closer the surface of the ground above. (Ding. polyt. Journ. ccvi, 345, abstr. by W. Smith).

PLANTS NEW TO GRAY'S MANUAL.—Three years ago, Miss Furbish of Brunswick collected at Boothbay, Maine, specimens of *Odontites rubra*. This is a pretty Euphrasioid plant easily distinguished from the White Mountain *Euphratia officinalis*. Last summer the same plant was collected by Prof. Rockwood, at

the same locality. It had been previously detected in Guysborough, Nova Scotia.

Crepis aurantiaca, formerly called *Hieracium aurantiacum*, appears to be naturalized in some places in Saco, Maine. It occurs in grounds adjoining a nursery, where it is associated with *Ajuga reptans*, a labiate plant. Probably both plants were introduced in the material employed in packing foreign trees.

ZOOLOGY.

A Remarkable Monstrosity.— I submit the history, anatomical examination and physiological peculiarities of this case of *lusus naturæ*, as one of especial interest to embryologists.

The subject, or subjects, are a pair of twin pigs united throughout the anterior abdominal, thoracical, cervical and cranial regions, having one umbilicus in common. As they now stand (Fig. 74), taxidermy having been resorted to, to preserve them, to ordinary observers, at first sight, their conjoint bodies present the appearance of two individuals standing face to face, being in juxtaposition above the umbilicus, with arms extended at right angles. Below the inferior point of union both are perfectly normal; above this region the front side * resembles the inferior part of the thorax of a normally formed hog. The back side presents the same thoracic appearance, but above it is seen the top of the head (the region posterior and between the ears in a normally formed hog) with two ears in juxtaposition at their point of junction with the head, situated in the median line, one and one-half inches posteriorly to the ones situated in the normal position.

Fig. 74.

Their external appearance, size, form and color are the same. Both are of the male sex. The head, anteriorly of the conjoint pair of ears, is normal in shape, being but slightly broader in the

* The terms front, back, etc., relate to the organization as a whole, the four posterior legs occupying the inferior position.

region of the normally situated ears than is common to this breed of hogs, the only external departure from normality being in the number of tusks, there being double the usual number. In the left side of the mouth the position of the four tusks is alternate, the anterior superior one being situated between the two in the inferior maxillary. On the right side, those in the inferior are anterior to those in the superior maxillary.

There was one sternum in common, situated on the front side; the ribs of each thorax extending about four lines behind it. On the back side the union was formed by muscular prolongations from the latissimus-dorsi, trapezoid and intercostal muscles.

The right pig had a right lateral curvature of the spine in the superior cervical region; the spine of the other having a double lateral curvature, the superior curve being to the left, in the dorsal region, the inferior one to right in the lumbar region.

The thoracic viscera were transposed at right angles, the right lung of each pig occupying the left side of the thoracic cavity of the other, and the left lungs being situated in the right sides of the respective thoraxes. The anterior trachea was connected with the lung situated in the left side of the right hog, and the lung situated in the right side of the left hog; the posterior trachea exhibiting a like connection with the other lungs. One lung, the one situated in the right side of the left hog, was much larger than the other three, respiration having taken place in it, the other three never having exercised that function.*

There was but one pericardium containing the two hearts.

The oral cavity, anterior to the pharynx presented a normal appearance, with the exception of the tusks, already referred to. The anterior glottis was situated normally. The posterior one was reversed in position, the epiglottis being situated on the posterior side; the œsophageal orifice being situated between the two.

In the abdomen were two livers, that of the right hog being of a pinkish hue; the other of a dark brown appearance. There was but one stomach, the œsophageal orifice being situated in the centre superiorly, the pyloric occupying a position directly opposite. The stomach, when inflated, presented the appearance of a sac, constricted throughout its centre in a vertical direction. The duodenum and jejunum were single; the latter, at its inferior ex-

* The hogs, when found, were lifeless, and were supposed to have been still-born.

tremity was bifurcated, beyond which there were two sets of viscera.

The cranial cavity was divided by a cartilaginous septum which separated the two sets of brains. Each set of spinal nerves entered its division of the cranium through its own *foramen magnum*. The cranial bones were normal in number and appearance save the occipital, which had two openings for the spinal nerve, each side of the median line, and processes for muscular attachment. The optic cavities were imperfectly formed. The eyes were not developed, a bundle of fascia with some nerve substance occupying their place.

The subject having been frozen and refrozen several times before it came into my possession, I was unable to pursue the anatomical investigation of the several structures to the extent that I desired, such processes having destroyed the cranial ganglia and nervous system, the microscope revealing the disorganized structures.

These hogs evidently had their origin in one ovum, with two nuclei or germinal centres situated equidistant from one another, and not from two ova which had become nucleally and anatomically commingled in the course of their development. — T. W. Deering, M. D., *Leavenworth*, *Kansas*.

Swarming of a Brood of Winged Ants.—On the afternoon of Oct. 6th, at about 4 P. M. we were attracted to a part of the large yard surrounding our home, by a multitude of large sized insects that filled the air, and appeared to be some unusual form of insect life, judging of them from a distance. On closer inspection, these creatures proved to be a brood of red ants (Formica) that had just emerged from their underground home and were now for the first time using their delicate wings. The sky, at the time, was wholly overcast; the wind strong, southeast; thermometer 66° Fahr. Taking a favorable position near the mass, as they slowly crawled from the ground, up the blades of grass and stems of clover and small weeds, we noted, first, that they seemed dazed, without any method in their movements, save an ill-defined impression that they must go somewhere. Again, they were pushed forward, usually, by those coming on, after them, which seemed to add to their confusion. As a brood or colony of insects, their every movement indicated that they were wholly ill at ease.

Once at the end of a blade of grass, they seemed even more puzzled as to what to do. If not followed by a fellow ant, as was usually the case, they would invariably crawl down again to the earth, and sometimes repeat this movement until a new comer followed in the ascent, when the *uncertain* individual would be forced to use his wings. This flight would be inaugurated by a very rapid buzzing of the wings, as though to dry them, or prove their owner's power over them; but which, it is difficult to say. After a short rest, the violent movement of the wings would recommence, and finally losing fear, as it were, the ant would let go his hold upon the blade of grass and rise slowly upwards. It could, in fact, scarcely be called flight. The steady vibration of the wings simply bore them upwards, ten, twenty or thirty feet, until they were caught by a breeze, or by the steadier wind that was moving at an elevation equal to the height of the surrounding pine and spruce trees. So far as we were able to discover, their wings were of the same use to them, in transporting them from their former home, that the "wings" of many seeds are, in scattering them; both are wholly at the mercy of the winds.

Mr. Bates, in describing the habits of the Saüba Ants (*Œcodoma cephalotes*) says,* "The successful *début* of the winged males and females depends likewise on the workers. It is amusing to see the activity and excitement which reign in an ant's nest when the exodus of the winged individuals is taking place. The workers clear the roads of exit, and show the most lively interest in their departure, although it is highly improbable that any of them will return to the same colony. The swarming or exodus of the winged males and females of the Saüba ant takes place in January and February, that is, at the commencement of the rainy season. They come out in the evening in vast numbers, causing quite a commotion in the streets and lanes." We have quoted this passage from Mr. Bates' fascinating book, because of the great similarity and dissimilarity in the movements of the two species at this period of their existence. Remembering, at the time, the above remarks concerning the South American species, we looked carefully for the workers, in this instance, and failed to discover above a dozen wingless ants above ground, and these were plodding about, very indifferent, as it appeared to us, to the fate or welfare of their winged brothers. On digging down a few inches, we

* Naturalist on the River Amazons, Vol. 1, p. 32.

could find but comparatively few individuals in the nest, and could detect no movements on their parts that referred to the exodus of winged individuals, then going on.

On the other hand, the time of day agrees with the remarks of Mr. Bates. When we first noticed them, about 4 P. M. they had probably just commenced their "flight." It continued until nearly seven o'clock P. M., or a considerable time after sundown. The next morning, there was not an individual, winged or wingless, to be seen above ground; the nest itself was comparatively empty; and what few occupants there were seemed to be in a semi-torpid condition. Were they simply resting after the fatigue and excitement of yesterday?

It was not possible for us to calculate what proportion of these winged ants were carried by the wind too far to return to their old home; but certainly a large proportion were caught by the surrounding trees; and we found, on search, some of these crawling down the trunks of the trees, with their wings in a damaged condition. How near the trees must be for them to reach their old home, we should like to learn; and what tells them, "which road to take?" Dr. Duncan states,* "It was formerly supposed that the females which alighted at a great distance from their old nests returned again, but Huber, having great doubts upon this subject, found that some of them after having left the males, fell on to the ground in out-of-the-way places, whence they could not possibly return to the original nest!" We unfortunately did not note the sex of those individuals that we intercepted in their return(?) trip; but we cannot help expressing our belief that, at least, in this case, there was scarcely an appreciable amount of "returning" on the part of those whose exodus we have just described; although so many were caught by the nearer trees and shrubbery. Is it probable that these insects could find their way to a small underground nest, where there was no "travel" in the vicinity, other than the steady departure of individuals, who, like themselves, were terribly bothered with the wings they were carrying about with them?—C. C. Abbott.

We have noticed that those females that do not return to the old nest found new ones. In Maine and Massachusetts we have for several successive years noticed the swarming of certain species

* Transformations of Insects, p. 205.

of ants during an unusually warm and sultry day early in September. See also this journal, p. 392.—Eds.

Habits of the Cut Worm. — I venture to send you an item in regard to the common cut worm (*Agrotis* or dart-moth) which is new to me. A friend recently related to me the results of some extended observations which were corroborative of some another friend made not long before. He found that the cut worms would come out of the ground at about nine o'clock in the evening; they did not vary many minutes from that time in all the observations he made. He used to watch them for hours, by the light of a lantern.

Sometimes he would put a tin or wooden box around the plant, just to see what they would do, and then occurred what seemed to me the most singular part of their performance. The worm would crawl towards the plant till it came to the box, then it would follow along the side of the box to find an opening, and if none were found, it would ascend the side of the box — whether of tin or wood—to the very top; reach around in every direction, and, if nothing could be felt, would turn and go back, down the outside of the box (never on the inside), and go into the ground. Sometimes he would bend the leaf of the cabbage plant so that the worm could touch it, when it would instantly take to the plant, follow it down till it came to the root, and then commence its work, *i.e.*, gnaw the stem off, and feed on the central portion of the same. The manner in which the worm feeds upon the grape was observed to be thus:—The worm would come out of the ground at its usual time, ascend the vine till it came to a new shoot, gnaw that off, and fasten itself to the stump of the branch so gnawed, and suck the sap of the vine till it was so full it seemed almost ready to burst, then descend to the ground and bury itself out of sight.—N. Coleman, *Grand Rapids,Michigan.*

Composition of Salmon. — Prof. Sir R. Christison lately communicated to the Royal Society the results of a chemical analysis of clean salmon (*i.e.*, those in good condition) and of the same species when exhausted or "foul." A mean of several trials gave, for the clean salmon, oil 18·53 per cent., nitrogenous matter 19·70 per cent., saline matter 0·88 per cent., water 60·89 per cent.; for the foul salmon, oil 1·25 per cent., nitrogenous matter 17·07 per cent., saline matter 0·88 per cent., water 80·80 per cent.

GEOLOGY.

Glacial Fossils in Maine.—The rocks in that part of Maine, lying along the coast between the Penobscot and Kennebec Rivers, are so folded as to form a series of N. N. E.–S. S. W. ridges with smaller plications between them. As the land rose after the melting of the glaciers, sedimentation seems to have gone on rapidly and animal life to have been abundant, while the water level was yet a hundred or two feet higher than at present. The principal folds of the rock strata then formed low hill ranges capped with glacial detritus, and in the fiords between these were accumulated immense quantities of fine clay (light gray, as derived from light colored gneisses and schists). This is usually separated from the bottom rock by a little more or less stratified gravel. As the clay neared the surface of the water, it became more sandy, of course, and passed occasionally into beds of gravel, particularly where the current was strong. These deposits finally emerged, and their record is now partly obliterated by running streams. The clay is found to contain small branches of silicified wood, and the upper strata contain beach shells.

In the town of Nobleboro, twenty or twenty-five miles from the coast, in the valley of the Damariscotta River (Lincoln Co.), the relations of these strata are well shown by a cutting of the Knox and Lincoln Railroad, which has now, I believe, a station about forty rods southwest of it. Nobleboro village is a mile south. The cut is twenty or thirty rods long through a hillside and is thirty-nine feet deep in the middle. Between the hill (which slopes off to a swamp,) and the station, there is a ledge of striated and water-worn gneiss, rather lower than the railroad grade. In the cut above the grade level are—

7. Soil with grass.
6. Sand and gravel curved over the lower strata parallel to the top of the hill.
5. Pebbly gravel, 2–4 feet from top of hill.
4. Sand and gravel.
3. Gravel and clay merging and alternating.
2. Brown clay sandier and drier than No. 1.
1. Blue clay several feet deep.

No. 1 contained decaying blades of eel grass quite abundantly; and the remains of several kinds of shells which were much decayed and generally mere casts; the first two kinds only have the shell solid. *Buccinum undatum* (two specimens); *Fusus decemcostatus* (8); Pecten (two species; one *P. islandicus*); *Serripes Grœnlandica* (10); numerous specimens of *Mya arenaria* and *Mytilus edulis* (3); *Leda*, a few small decayed valves, possibly of Macoma; also what appeared to be the shell of a small crustacean, not an inch long.

In No. 3, the pebbles were conglomerated with oxide of iron in one place.

No. 5, a loose narrow stratum, evidently deposited in shallow water, held many broken and worn shells of clam, mussel, *Macoma fusca* and *Leda Jacksoni.*

No. 6 seems to mark the emergence of the beds, showing a change in the water courses produced by the elevation of some higher land than at this point, from the water. — Paul Sherman.

ANTHROPOLOGY.

Prehistoric Culture of Flax.— Dr. Oswald Heer, the eminent botanist, and one who has devoted so much attention to the structure and history of fossil plants, publishes an article upon flax and its culture among the ancients, especially the prehistoric races of Europe. His memoir may be summarized as follows: First, flax has been cultivated in Egypt for five thousand years and that it was and is one of the most generally diffused plants of that country. It occupied a similar position in ancient Babylonia, in Palestine, and on the Black Sea. It occurred in Greece during the prehistoric period, and at an early date was carried into Italy, while its cultivation in Spain was probably originated by the Phœnicians and Carthagenians. Second, it is also met with in the oldest Swiss lacustrine villages, while, at the same time no hemp nor fabrics manufactured from wool are there to be found. This is considered a remarkable fact, since the sheep was one of the oldest domestic animals, and was known during the stone period. The impossibility of shearing the fleece by means of stone or bone implements is supposed to have been the reason why woollen fabrics were not used. It is thought probable that the skin, with

its attached wool, was made use of for articles of clothing. Third, the lake dwellers probably received flax from Southern Europe, from which section fresh seeds must have been derived from time to time. The variety cultivated was the small, native, narrow-leaved kind from the coast of the Mediterranean, and not at all that now raised in Europe. It must, therefore, have been cultivated also in Southern Europe, although Dr. Heer could not ascertain among what people and at what age this took place. If this could be ascertained it would be an important point in the determination of the antiquity of the lake dwellers. Fourth, at the time of the empire both summer flax and winter flax were cultivated in Italy, as now, but in what form it was grown in ancient Egypt is not determined. It is thought probable that the narrow-leaved variety was first introduced and after that the Roman, and then the common varieties followed. The common plant has doubtless arisen from the cultivation of the narrow-leaved, while the Roman winter flax and the *Linum ambiguum* constitute the intermediate stages. The original home of the cultivated flax was therefore along the shores of the Mediterranean. The Egyptians had probably cultivated it, and from them its use was doubtless disseminated. It is possible that the wild variety and the winter flax were grown elsewhere at the same time, when the cultivated variety had long since driven them out of use in Egypt.—*Nature.*

"INDIAN NETSINKERS" IN NEW JERSEY.—Both the netsinkers and hammerstones, as described by Mr. Rau, in the March number of the NATURALIST, are exceedingly abundant in many localities in New Jersey. Especially along the banks of the Delaware River, and about the creeks that empty into that river, we have found the "sinkers," literally, by hundreds. They are now so abundant in the bed and about the shores of Watson's Creek, Mercer Co., that we do not pretend to gather them, when collecting unless one of unusual shape or size attracts our attention. The collection from this state, made by the writer, and now in the museum of the Peabody Academy, Salem, Mass., contains many specimens identical in all respects with those figured on page 140 of the present volume of this journal; unless it be, that the majority are somewhat smaller and less heavy than the average of the "Muncy" specimens.

The remarks of Mr. Rau, on the hammerstones found associated with the "sinkers," at Muncy, will only in part apply to this same

class of relics, found in the neighborhood of Trenton, New Jersey. So far as the writer's experience in collecting goes, these hammerstones are found away from the water, on the sites of villages, and more particularly on the sites of the operations of arrowhead makers. Curiously enough, too, the average weight of these hammer-stones is greater, as we have found them, than the average weight of those found at Muncy, Pennsylvania, by Mr. Rau. Always associated with the ordinary hammerstone, which is that with a depression on either side, for the ends of the thumb and second finger, is a smaller cylindrical hammer, of harder mineral, with nothing to indicate that it is a "relic," other than the well battered ends, which are as well marked in these specimens, as the similar batterings and finger pits are in the typical hammerstones. — CHARLES C. ABBOTT, M. D.

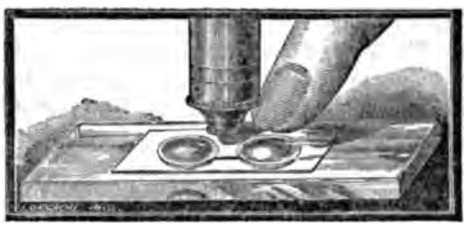
ANTIQUITY OF MAN IN AMERICA. — In the December number of this Journal we made an abstract of a paper printed by the Philadelphia Academy, in which Mr. Berthoud gave an account of the relics of an early race of men. As the geological position of the relics has been questioned, further information is very desirable.

MICROSCOPY.

A NEW SLIDE FOR THE MICROSCOPE.—At a recent meeting of the Optical Section of the Franklin Institute, there was described and exhibited in operation a new adjunct to the microscope, designed by Mr. D. S. Holman, a member of the section, whose life slide recently attracted so much attention and comment. The new device may be called a current cell, or moist chamber, and is designed to afford the microscopist the opportunity of observing and studying the constitution of the blood and other organic fluids with much greater ease and precision than it has heretofore been found possible to attain. The accompanying illustration will serve to make the description of its construction and operation manifest: The slide consists of a plain piece of plate glass of considerable thickness, and three inches by one in dimensions. This is furnished at equal distances from its centre with two well polished shallow cavities of circular form, which are connected with each other by one or more capillary channels. These channels are likewise polished, and to permit of a greater field in

focussing for their contents, the groove of the tube is made triangular in section, with one side forming a right angle with the surface of the slide, and the other forming with it a very large angle. The arrangement of the cell, or moist chamber, is as follows: In order that the current shall be most sensitive, the slide should first be brought nearly to the temperature of the body by holding it for a few minutes in the hand. A small quantity of the liquid to be examined (blood, for example), is then to be placed in each cell, and a thin cover glass placed upon them. If held down for a moment with the hands, the air within the cavities will become slightly rarified, and the cover glass so firmly held in place by atmospheric pressure as to require no artificial attachment. Upon removal of the fingers, it will be found that the centre of the cavities is occupied with a bubble of air, while a thin annulus about the circumference, as well as the connecting capillary tubes, is

Fig. 75.



occupied by the fluid. The slide is now ready for inspection. If placed beneath the microscope, and the instrument is focussed upon the connecting channel, a number of corpuscles, red and white, will be observed, but quite quiescent. Let the finger be now approached to the neighborhood of either cell, when at once a current, more or less rapid, according to its proximity, commences to flow beneath the object glass; remove the finger, and the direction of the current is reversed. The current is caused by the expansion of the air bubble in the cell, in consequence of the heat radiated from the finger; and its rapidity may be controlled to a nicety by regulating the proximity of the finger. So sensitive is the apparatus, that even with the highest powers, a corpuscle, granule or cell in the field of view, may be leisurely turned over and over in any desirable position, thus affording an unequalled means of observation and study to the microscopist; and while the eye is examining at leisure the behavior of the objects beneath it, the

mind is charmed with the simplicity of the means by which these motions are controlled. In the cell here described, no foreign liquid is added to the material under examination. Moreover, if each cell be entirely filled, but with liquids of different densities, the cell holding the denser liquid being placed slightly uppermost upon the rotating stage of the microscope, the action of gravity will cause two currents to flow in opposite directions through the communicating channels, and in this way the phenomena of transfusion, crystallization, etc., may be observed for a considerable length of time, which otherwise are brought to sight only with difficulty. At the conclusion of the description, the ingenious and useful device was highly praised by those members present, who were best able to appreciate its value, and its exhibition beneath the microscope was the occasion of much interest.

AERIAL STAGE MICROMETERS.—Dr. Pigott has called the attention of the Royal Microscopical Society to a novel mode of using micrometers. He places the micrometer below the achromatic condenser, and thus employs its image as a stage micrometer, focussing the condenser so as to make the image of the micrometer coincide with the plane of the object on the stage. This remedies the greatest defect of other stage micrometers (as Fraunhofer's), since the accuracy which is necessarily diminished in proportion to the magnifying power employed, is at the same time increased by the whole amplifying power of the achromatic condenser. Hence this arrangement more nearly resembles in accuracy the ocular micrometers, and it might with nearly equal propriety be called an eye-piece micrometer, since its second image is formed in the ocular along with that of the object. It possesses the valuable property of reading off the size of objects directly, without troublesome computation and without allowance for the power of the ocular. Either the cobweb micrometer or the lines ruled on glass may be used, and the arrangement should be such that the micrometer lines should appear on the stage in precisely a definite proportion of their natural size. An accuracy of $\frac{1}{120000}$ of an inch is theoretically quite attainable by this plan. With the cobweb micrometer this arrangement seems nearly faultless, save the first trouble of combining the apparatus so as to get a perfectly accurate reading: but, with lines on glass, the glass plate, with its imperfections as well as its lines, necessarily gives an image which

is perhaps as annoying as if the plate, instead of its image, were in the focus of the eye lens.

THE MICRO-SPECTROSCOPE. — Dr. E. J. Gayer has contrived and published in the Transactions of the Royal Microscopical Society, a micro-spectroscope consisting of a collimating lens and one or more prisms occupying the position of the ocular, and immediately above these a telescope, suitably inclined, for examining the spectra. According to Hogg, and other authorities, the first application of the spectroscope to the microscope was made by Mr. H. C. Sorby who placed a triangular prism below the stage, the object being situated in the spectrum. As this was inapplicable to opaque objects, Mr. Huggins proposed to adapt a direct vision spectroscope to the ocular, which he accomplished by inserting the collimative-tube of a star spectroscope into the body of the microscope in the usual position of the eye-piece. The Sorby-Browning contrivance has so completely superseded these arrangements that they have been nearly forgotton, and Dr. Gayer has rediscovered Mr. Huggins' arrangement without knowing it. He combines with it the Sorby-Browning plan of adding a side stage for the comparison of spectra, and seems to secure an increase of light by placing the slit nearer the objective, about an inch above it. On the other hand, those most familiar with the Sorby-Browning eye-piece form, claim that it has sufficient light and dispersion for its use, and that its absorption bands are not only wide enough but more distinct than if magnified by a telescope.

BLIGHTS ON TEA AND COTTON. — Mr. M. C. Cooke describes a new species of fungus occurring on blighted leaves of the tea plant, from Cachar, India. "*Hendersonia theæcola* Cooke, Perithecia globose, black, prominent, pierced at the apex, scattered over both surfaces, or subgregarious ; spores cylindrical, rounded at the ends, triseptate, pale brown, on long hyaline pedicels (.0004–.0005 in.), .01–.0125 millimetres long without the pedicels: on leaves of *Thea*." Picking off the diseased leaves and burning them is the only remedy suggested for this blight, which shares with the punctures of an unknown insect the credit of destroying the plants.

Seeds of American cotton naturalized at Dharwar, India, affected with " Black blight," manifested but little injury externally, but on being crushed were found to be filled with a sooty powder appearing like the spores of an *Ustilago*. On closer examination

Mr. Cooke became satisfied that the spores were originally concatenate, though soon breaking up into subglobose individuals, and he therefore describes them as a new species of *Torula* (*Torula incarcerata* Cooke) notwithstanding their anomalous habitat. As a *Torula* it must be considered a sequence rather than the cause of the decay of the seed, while the opposite would be fairly presumed of an *Ustilago*.

Iridescent Engraving. — Mr. Rutherford of New York, long ago contrived a machine, worked by an electro-magnetic engine, which ruled upon glass microscopical test objects consisting of lines of iridescent fineness; and the beautiful iridescence of Nobert's lines by opaque or dark-field illumination is almost as familiar to microscopists as that of mother-of-pearl or of some of the diatoms.

Recently Mr. Wm. A. Rogers of the Cambridge Observatory has engraved upon glass, lines of great beauty and considerable fineness. Those of medium fineness, especially, glisten beautifully with rainbow-colored light. The lines from $\frac{1}{32}$ inch to $\frac{1}{2400}$ inch, suitable for use in optical instruments as a substitute for spider-web or diamond rulings on glass, are remarkably clear, distinct and uniform in their spacing; while the finer lines excel in fineness and distinctness any engraving previously seen by the writer. Those of $\frac{1}{20000}$ inch are perfectly successful, while those of $\frac{1}{24000}$ inch are capable of being defined and counted. Some of Mr. Rogers' engraving are made in stars like Mr. Stanistreet's lines.

Apertures of Objectives. — The Tolles' $\frac{1}{10}$, sent to London as proof of the utilization of more than 82° aperture in balsam, has been carefully examined by Messrs. C. Brooke, H. Lawson, W. J. Gray and S. J. M'Intire, who report an angle in air of 145°, in water 91°, in balsam 79°. Mr. Wenham believes the balsam angle might have been three degrees higher in hard instead of fluid balsam. Doubtless four more competent judges could not have been selected in the world, and their report will be likely to be generally accepted unless it can be shown that a higher angle might have been utilized at some other point of practically useful adjustment, a question which they can scarcely have failed to consider in preparing the report.

Under-corrected Objectives.—The advantage of these lenses, which have only lately attracted much attention, was distinctly and practically acknowledged by Mr. Wales in the year 1865. At that

time he patented his well known objectives with two backs; one back being calculated to give a result of perfect correction for color, this being required by many microscopists, and being desirable for many kinds of work; and the other back having the lens slightly undercorrected for color, for better performance in photography and in extreme resolution by oblique light. It was, and is, claimed by Mr. Wales that such combinations furnish to microscopists a really valuable choice of qualities and of working power in objectives.

Students' Microscopes.—Since the publication in this Journal of a paper on the above subject, J. W. Queen & Co. have greatly improved their model of students' microscope, availing themselves liberally of the modern suggestions on the subject. They have also introduced, under the name of Popular Microscope, a simplified and cheapened form which seems fully equal to the old style of students' stand. Experienced microscopists will be the first to appreciate the efforts of manufacturers to furnish really good instruments at a price which will render them popular and thereby extensively useful.

A New Ocular Micrometer. — Dr. Pigott advises that the lines of an eye-piece micrometer be engraved on a plano-convex lens of long focus, such as a spectacle glass. As he explains that the convexity is too slight to appreciably alter the effect of the ocular, this form can only excel in ease of obtaining accuracy of workmanship, as compared with the commonly used contrivance of a stage micrometer cut down to such size as to lie in the focus of the eye-lens.

Blood-disks of the Salmon. — Mr. George Gulliver called the attention of the East Kent Natural History Society to the preëminent size among osseous fishes, of red corpuscles of the blood of the salmon family, those of *Salmo fontinalis* having a mean length of $\frac{1}{1455}$ inches and breadth of $\frac{1}{2286}$ inches. On account of this peculiarity of size, "Science Gossip" aptly suggests the choice of this blood to novices in microscopy who desire to study the blood of fishes.

The Highest Power. — Messrs. Powell & Lealand have completed and exhibited a one-eightieth inch objective which has an angular aperture of 160°, works through glass covers .003 thick,

and is fairly up to its nominal power, giving an amplification of 4,000 with the lowest ocular. It is said to give sufficient light and good definition. Its working properties are little known at present.

RED BLOOD CORPUSCLES. — Mr. Malassez notices a general tendency of these bodies to diminish in number and increase in size in the lower animals. The following figures indicate the estimated number to a cubic millimetre; in the goat, 18,000,000; in the camel, 10,000,000; in man, 4,000,000; in the porpoise, 3,600,000; in birds, 4,000,000 to 1,600,000; in osseous fishes, 2,000,000 to 700,000, and in cartilaginous fishes, 230,000 to 140,000.

NATURE OF MARKINGS. — Dr. Pigott believes the spherules of butterflies' scales to be more difficult of resolution than equally separated lines in Nobert's bands. On the other hand, it has been believed that diatom markings were more easily resolved than Nobert's lines of equal fineness; a difference which, if confirmed, might give some hint as to the nature of the various markings.

MICROSCOPIC TOYS. — Mr. T. Curtiss sent for exhibition at a meeting of the Brighton and Sussex Natural History Society, slides consisting of a variety of figures of flowers, insects and birds, artificially formed of beautifully arranged scales of butterflies and moths. Some of the figures consist of as many as 400 scales, and all were considered wonderfully perfect and beautiful.

THE VALUE OF ILLUMINATION. — Mr. Hogg stated, at a meeting of the Royal Microscopical Society, that with Wenham's new illuminator he resolved *N. rhomboides* very satisfactorily with a $\frac{1}{4}$ objective made by Andrew Ross twenty-five years ago. Probably this was a $\frac{1}{5}$ by present nomenclature.

A NEW SOCIETY. — A "Medical Microscopical Society" has been organized in London, under the presidency of Mr. J. Hogg.

NOTES.

THE daily press has made us familiar with the facts, so far as known, regarding the death of Capt. Hall of the Polaris. His ship penetrated two hundred and sixteen miles (Lat. 82° 16′) farther north than Dr. Kane, or in fact any other vessel. Capt. Parry attained a more northern point by means of sledges. Hall

claimed that Kane's Polar sea is a strait fifteen miles wide. He crossed it in a sledge journey, from which he returned to die aboard his ship.

We are sanguine that the Polaris will be found, and that the scientific results will be commensurate with the care taken in the outfit at Washington and the selection of men to conduct observations. It will be remembered that the chief of the scientific corps is Mr. Emil Bessels, a most promising naturalist, author of several works on the embryology of the invertebrates, and of an unpublished memoir on the embryology of insects. Meanwhile we must wait anxiously, perhaps for three or four months, before knowing of the fate of Bessels and his comrades.

DR. E. COUES has been attached to the International British Northern Boundary Survey of the 49th parallel, which takes the field on the first of June.

THE New Albany, Ind., Society of Natural History is doing good work in developing the natural history of Indiana and has several active workers in its ranks. Located in a rich fossiliferous region, also in the locality of several caves and subterranean streams, we look to the members of this society for important additions to our knowledge in these departments, and we are also pleased to note that they are doing much in collecting the stone and bone relics of the former inhabitants of the region, having already made a large and important collection of specimens, as we can testify from a visit of two years ago. The officers of the society for the following year are—*President*, John Sloan; *Vice Presidents*, Charles Hutchinson and F. L. Morse; *Secretary*, W. W. May; *Treasurer*, J. K. Walts; *Librarian*, Frank Spellman; *Curators*, W. A. Clapp, Wm. Borden, S. L. S. Smith, John Williamson, Wm. Clark.

THE Papers on Natural History read at the Washington meeting of the National Academy of Science in April, 1873, were on the following subjects:—Biographical Memoir of Dr. John Torrey, by Dr. Asa Gray; On Reproduction in Progeny of Defects produced by Injury in Parents, by Dr. Charles E. Brown-Sequard; On the Unity of the System of Life in Animals and the true principle of Gradation in the various Animal Types, by Prof. A. Guyot. The following members were elected:—Professor Elias Loomis, Prof. Joseph Lovering, Prof. W. A. Norton, Dr. Theodore Gill, Dr. J. J. Woodward.

WE regret that Professors Marsh and Cope have considered it necessary to carry their controversy to the extent that they have. Wishing to maintain the perfect independence of the NATURALIST in all matters involving scientific criticism, we have allowed both parties to have their full say, but feeling that now the controversy between the authors in question has come to be a personal one and that the NATURALIST is not called upon to devote further space to its consideration, the continuance of the subject will be allowed only in the form of an appendix at the expense of the author.

BOOKS RECEIVED.

Preliminary Descriptions of Three New Species of Cetacea from the Coast of California. (From Proc. Cal. Acad. Sci.) By W. H. Dall. Jan. 29, 1873. 8vo, pp. 2.

Ninth Biennial Report of the Superintendent of Public Instruction of the State of Illinois. By Newton Bateman. 8vo, pp. 231. 1871-1872.

Principles de Biologie appliques a la Medicine. By Ch. Girard. 12mo, pp. 108. Paris, 1872.

Schriften des Vereins zur Verbreitung naturwissenschaftlicher Kenntnisse in Wien. 12mo, pp. 415. With 2 woodcuts. Band xii. Jahrgang, 1871-2. Wien, 1872.

Bulletin de l'Institut National Genevois. 8vo. No. 36. Vol. xvii, pp. 1-216, with map. Geneve, 1872.

Bulletin Mensuel de la Societe d'Acclimatation. 8vo. Second Series. Tome ix. No. 11. November, 1872. Paris.

Bulletin Entomologischer Zeitschrift. 8vo. Jahrgang 16. Parts 2-4. With 3 plates. Berlin, 1872.

Memoires de la Societe de Physique d'Histoire Naturelle de Geneve. 4to. Tome xxi. Second Part. With 20 plates. Paris, 1872.

The Half-yearly Abstract of the Medical Sciences. Vol. lvi. January, 1873. Philadelphia.

Chart of Geological Nomenclature intended to express the relation of Minnesota to the great Geological Series of the Earth, and the probable equivalency of some of the names the formations have received in the various States and in Europe. By N. H. Winchell.

On the Glacial and Champlain Eras in New England. 8vo, pp. 16. (From the Am. Jour. Sci. and Arts, Vol. v, Mch., 1873.) By James D. Dana.

Transactions of the Eclectic Medical Society of the State of New York for the year 1871. 8vo, pp. 365. Albany, 1871.

Notes on the Avi-fauna of the Aleutian Islands from Unalashka eastward. By W. H. Dall. 8vo pp. 11. (From Proc. Cal. Acad. Sci.) San Francisco, 1873.

Proceedings of the Royal Society. Vol. xx. Nos. 130-137. 8 pamphs., 8vo. London, 1871-72.

List of Members of the Royal Society. 4to, pp. 31. London, Nov. 30, 1871.

Philosophical Transactions of the Royal Society of London. 4to. Vol. clxi. Part 2. 1871. Vol. clxii. Part 1. 1872. London.

The Depths of the Sea. By C. Wyville Thompson. 8vo, pp. 527. *Illustrated.* Macmillan & Co. New York and London. 1873.

The Relations of Botany to Agriculture. By William S. Clark. 8vo, pp. 29. Boston, 1873.

List of Coleoptera in the Collection of George Dimmock, No. 679 State Street, Springfield, Mass. 8vo, pp. 39. Springfield, 1873.

The Entomologist's Monthly Magazine. London, Feb., Mch., Apl., May, 1873.

The Scottish Naturalist. Perth, Jan., 1873.

Grevillea. London, January - May, 1873.

Feuille des Jeunes Naturalistes. Paris, Feb. 1, 1873.

The Lens. Chicago, January, April, 1873.

Nature. London, Jan. 30 - May 8, 1873.

Science Gossip. London, Feb., Mch., 1873.

The Field. London, Feb. 1 - May 10, 1873.

The Popular Science Monthly. New York, March - June, 1873.

The Canadian Entomologist. London. Vol. v. January, March, 1873.

Land and Water. London, Feb. 8 - May 10.

American Journal of Science and Arts. New Haven, March - May, 1873.

Revue Scientifique. Paris, Feb. 8 - May 10.

Journal of Botany. London, Feb. - May, 1873.

The Academy. London, Feb. 15 - May 1, 1873.

Journal of the Franklin Institute. Philadelphia, March - May, 1873.

Essex Institute Bulletin. Salem. Vol. iv. Nos. 9, 10, 11, 12, 1872; 1 and 2, 1873.

The Canadian Naturalist and Quarterly Journal of Science. Montreal. Vol. vii, No. 1.

Le Naturaliste Canadien. Quebec. March, April, May, 1873.

Bulletin of the Torrey Botanical Club. New York. March, April, 1873.

American Journal of Medical Sciences. Philadelphia. April, 1873.

Quarterly Journal of Microscopical Science. London. January, April, 1873.

Proceedings of the California Academy of Sciences. San Francisco. Vol. iv, Part 5.

Bulletin of the Buffalo Society of Natural Sciences. Buffalo. Vol. i, No. 1, 1873.

Proceedings Academy Natural Sciences. Philadelphia. Part 1. 1873.

Transactions of the American Entomological Society. Philadelphia. Vol. iv. Nos. 1-3.

The Geological Magazine or Monthly Journal of Geology. London. Nov., 1872 - May, 1873.

Journal of the Quekett Microscopical Club. London, Oct., 1872, Jan., Apr., 1873.

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THE PRAIRIE WOLF, OR COYOTÉ: CANIS LATRANS.

BY DR. ELLIOTT COUES, U.S.A.

A large amount of fresh material, gathered on the Upper Missouri, may furnish some data bearing upon the question, now agitated, of the resemblance of the coyoté to the dog of the bronze period. The examination is made of about twenty skins with skulls, and several specimens in the flesh. I compare them with a dog very nearly of the same size; selecting for this purpose a thorough-bred pointer—an animal which, in its enlarged brain-box, shortened muzzle, pendulous lips, long, loose, silky, drooping ears, close, glossy coat and rat-like tail, departs as much, perhaps, as any breed, from an original stock, in all the fortuitous points engrafted through domestication. Even in this case the likeness in all essential respects is striking; and, as shown in the sequel, specimens of Indian dogs of this region can be found not certainly distinguishable from a coyoté, for a reason that will be evident. The differences between the coyoté and pointer become reduced to character of pelage and physiognomy; while the facial aspect itself, so strikingly diverse in its entirety, appears, when analyzed, much less substantially different.

To begin with size and proportions: it appears from the following measurements that the pointer and coyoté differ less in these respects than the normal individual variation among coyotés them-

selves; and that there is no essential discrepancy whatever in general "build":—

COMPARATIVE MEASUREMENTS OF A MEDIUM SIZED MALE POINTER AND SEVERAL COYOTÉS OF BOTH SEXES.

The measurements are given in inches and decimals.

MEASUREMENTS.	Pointer ♂ Dog.	Large ♂ Coyoté. No. 2692	Medium ♂ Coyoté. No. 2735	Large ♀ Coyoté. No. 2732	Small ♀ Coyoté. No. 2731
Standing height at shoulder........ ..	24	24	21	22	19
Tip of nose to root of tail............	36	36	33	34	28
Tail to end of vertebræ...............	13	14	12	14	11
Tail to end of hairs..................	14	18	15	16·50	13·50
Tip of nose to eye....................	4	4	3·75	4	3·50
Tip of nose to ear....................	8	....	7·50	7·75	7
Tip of nose to occiput................	9	8·50	8·25	8·50	7·50
Elbow to end of fore claws...........	14	13·25	12	12·50	11·50
Knee to end of hind claws............	16	16·25	13·50	....	....
Heel to end of hind claws............	8	7·25	6·75	7	6·50
Width across eyes at inner canthus...	2·50	....	1·60	....	....
Width across eyes at outer canthus...	4·25	....	3·25	....	....
Width across inner base of ears......	6	....	4	....	....
Height of ear above notch............	5	....	4	....	....
Width across tips of outstretched ears	15	....	11·75	....	....
Greatest width of ear pressed flat....	3·25	....	3·25	....	....
Tight girth of muzzle at middle.......	8·50	....	7·50	....	....
Tight girth of chest..................	26	....	19	....	....
Tight girth of belly..................	23	....	16·50	....	....
Longest hairs of back................	1·50	....	5	....	....
Width across hairs of tail pressed flat.	....	....	8·50	....	....

The coyoté appears more stoutly built, but this is deceptive, owing to the dense furring; the various girths show the contrary. It is, however, somewhat more "compact," the limbs lacking a certain freedom of swing, if not being slightly shorter.

It would not be much to the point to compare the pelages, since the cultivated coat of the pointer differs quite as much from the shaggy one of numerous other dogs, as from that of the coyoté. It is interesting to observe, however, that even the closest-haired

pointer shows, in anger, a slight though decided "mane." The mane of the coyoté is very conspicuous, the longest hairs over the back measuring four to six inches. The furring of the tail is as extremely diverse. The tail of a coyoté ordinarily droops to the suffrago, the hairs reaching beyond half-way to the heels; it is perfectly straight; the "brush" is terete-tapering, perhaps not quite so full for its length as that of a fox: in absolute size it is just intermediate between that of a *Vulpes velox* and *V. macrourus*, both of which are smaller animals. But furring aside, we find in the total lack of curve in the thorough-bred pointer's tail, a curious coincidence if nothing more. This straightness, prized by sportsmen, the result of breeding, and often cruelly insured by removal of the terminal joints so that some of the tendons lose insertion, is a feature in which the pointer departs from most dogs (the curly tail has been laid down as a specific characteristic of "Canis familiaris"), and resumes that of the coyoté.

Fortuitous conditions of pelage aside, the physiognomy, an almost equally casual matter, is the most striking difference between the two. It is difficult to portray an animal's facial expression in words; in this case we can hardly do better than to say that the aspect is just between a wolf's and a fox's, but more "doggy" than either. Audubon's figure is good; if anything, the front view of the upper figure is too "foxy." The coyoté's face would be exactly matched by that of many cur-dogs, especially slender-nosed kinds, did it not lack almost entirely the frontal prominence of the latter, a feature which in some kinds of lap-dogs is exaggerated into monstrosity. The upper profile of the coyoté's face, from occiput to snout, deviates not much from a straight line, the forehead being remarkably flat. This flatness gives an appearance of breadth that is deceptive, the real width being both absolutely and relatively less than in the pointer. But the width across the ears of the pointer (six inches instead of four) is largely produced by the drooping of these organs down the side of the head. The lips are thin and scant, ordinarily showing th teeth, always parting after the animal is dead. There is something peculiar about the eyes; they seem to look more directly forward than those of the pointer. They are set very near together, the inner angles being only about an inch and a half apart, yet the obliquity carries the outer canthi over three inches apart. The ears are very large, triangular, pointed, upright, with very stiff

cartilage. When pressed apart, their tips form with the point of the snout a nearly equilateral triangle. In fine, the pointer's physiognomy differs from the coyoté's mainly in its special engrafted features, and these produce a discrepancy much greater than that existing between the coyoté and many mongrel dogs.

It is unnecessary to compare the skulls of the animals. There are no differences of moment, at least viewing the immense discrepancies existing in the crania of different breeds of dogs. Nor does an "average" dog's skull differ from a coyoté's by anything like as much as do the skulls of *C. latrans* and *C. lupus*.

It appears, then, that the pointer, though a highly specialized case of the domestic dog, is identical in essential structural points with the coyoté; differs less in size than coyotés vary among themselves; differs no more in pelage than it does from many other dogs; and, in details of form and physiognomy, differs vastly less than various dogs do among themselves. It appears, furthermore, that close as the likeness is, it is less than that subsisting between the coyoté and various kinds of dogs domesticated by the Indians.

For example, there is nothing in Audubon's description of the Hare-Indian dog specifically inapplicable to the coyoté. Even the colors are the same; the difference in pattern (masses of blackish instead of brindling) is not of the least consequence, since it is entirely unstable. Richardson noted close traits of resemblance, even to the remarkable mode of outcry—a few, short, sharp barks followed by a prolonged shrill howl. The fact that this particular strain of dog is bred beyond the present distribution of the coyoté, is, of course, not to the point in the general question. But we have much more striking and unquestionable evidence of relationship by direct descent of some Indian dogs from the coyoté. In the first place we should note that the habitual antagonism of these dogs and the coyotés is nothing but the animosity all dogs show to strangers of their own kind, an aversion probably rooted in jealousy, which is a strong canine trait. Next, we continually find dogs of both sexes, on the frontier, deserting their haunts at particular (sexual) periods; and if the occurrence of a feral wolf-dog (coyoté ♀ and dog ♂) has not been recorded, there are numerous cases of the production of the same (from coyoté ♂ and dog ♀) in domestication. I have, finally, information which I consider perfectly satisfactory, in still stronger evidence of the readiness with which the two animals interbreed. Indians not unfrequently bring it

about themselves; on suitable occasions they picket out their ♀ dogs over night, to procure the cross, with constant success. What profitable quality is secured, I do not know; but such is the case. These crosses are not known to be otherwise than fertile; and the result is, in every Indian community there are mongrel dogs shading into coyotés in every degree; all having the clear wolf strain, and some being scarcely distinguishable from a prairie wolf.

The matter of color merits passing mention. The coyoté is as constant in this respect as other feræ, and I think its peculiar coloring can be reasonably traced in certain dogs. The animal is dingy white as a ground color, which remains so on all the under parts; above it is suffused with tawny-brown (bright in summer, paler and more grayish, or quite gray, in winter), this color overlaid with a clouding of black. This black is rarely uniformly distributed; it tends to streakiness along the back and across the shoulders and hips, producing a pattern similar to that of a "brindled" bull-dog. But there is a more striking feature, and one very characteristic of the animal (the brindled gray and black being shared exactly by an ordinary strain of *C. lupus*). The top of the muzzle, back of the ears, and outside of both fore and hind legs, are usually nearly uniformly tawny. This shade is precisely the so-called "tan" of the black-and-tan terrier, and has the same general distribution. In an attempt to trace pedigree, a fact of this sort seems to rank in value with the appearance, in a horse or mule, of the stripes of a quagga-stock.

THE IRREGULAR MIGRATIONS OF BIRDS.

BY T. MARTIN TRIPPE.

THE annual migration of birds; their moving north and south in the spring and autumn, is obvious enough to every one. In its various phases it is well discussed in various ornithological works, and is pretty thoroughly understood, comparatively speaking at least. But in addition to their vernal and autumnal changes of habitat, movements occasionally take place among birds not depending upon the seasons; invasions as it were of certain prov-

inces where they were before unknown, and a disappearance from their former range. Similar movements take place and, indeed, are constantly going on, among all ranks of the animal and vegetable kingdoms, though owing to their preëminent mobility, birds afford the most conspicuous examples, excepting, perhaps, the class of insects. The slow but sure progress of the Norway rat from the east is well known, it having gradually spread itself in the course of one hundred and fifty years, from Persia to the Pacific Ocean. The steady eastward march of the Colorado potato bug is another example, while among plants, *Leucanthemum vulgare* and *Rudbeckia hirta* afford familiar instances.

Audubon speaks of the chestnut-sided warbler as one of the rarest Sylvias of his day. In his "Ornithological Biography," he tells us that he searched for it for years in vain; and finally on obtaining five specimens in the same spring, considered himself extremely fortunate. At the present day it is, in the very regions where Audubon spent years in collecting, one of the commonest warblers; and the most inexperienced collector could shoot, not five, but five hundred in one season; indeed I have seen it far outnumbering all the other species together, and literally swarming in the woods. At the same time, the mourning warbler, rare in the time of Wilson and Audubon, remains quite as much so still; only in certain other localities it has been found very abundant. Now it is not to be supposed that the former species could have been common in the eastern states, and yet have eluded the observation of Audubon; and it is not at all probable that their present abundance is owing to the natural increase of the species. Plainly there must have been a migration or extension of range from some other region where it was at that time abundant; and in the same manner the next fifty years may see the mourning warbler extending its limits further and further eastward from Minnesota, where it is now common, until it is as abundant in the Atlantic States as the chestnut-sided warbler.

A somewhat similar case, but occurring in a much more limited space of time, happened in my own experience. In a series of several years' close observation at Orange, New Jersey, I searched for the great-crested flycatcher (*Myiarchus crinitus*), year after year, but all in vain; and what made the fact very singular was, that twelve or fifteen miles off, I had seen the bird sufficiently often to convince me that, if not common, it was by no means rare. Yet

for some inexplicable reason it did not inhabit the country immediately about Orange, for, although in the woods nearly every week for years, I never saw it until, after I had almost despaired of ever finding it, I did succeed in shooting a single specimen. This was in the fall; the next spring I saw a pair. In the summer, I went away; and, after an absence of two years, returning to Orange, I strolled through the woods, my old hunting grounds, and, to my surprise, almost the first bird I saw was the great-crested flycatcher. Subsequently I scarcely ever took a walk through the woods, without seeing or hearing it.

Now for what reason it had neglected quite an extensive range, in every way suited for its habits, and what impelled it so suddenly to invade and occupy that region, I cannot possibly imagine, as the woods had undergone but little change in that brief period and that little by no means prejudicial to its habits.

The purple finch was another instance of the same character, though less striking, from its known erratic disposition. For three years, I never saw more than a single pair; then it made its appearance during an unusually cold and stormy fall, in large numbers, and after that, for several years it was a regular spring and autumn visitor, so that I came to look for it as regularly as the robin or fox sparrow. The pine finch, also erratic, I never saw at all, for five years; then it appeared in great numbers just before a severe winter, and thereafter, for a space of several years, it was a regular winter visitor, staying till late in March, and coming as regularly in mild seasons as in cold.

In the time of Wilson, the redheaded woodpecker was one of the very commonest birds of the orchard and farm; and so abundant and familiar were they that, at the time of his writing his account of that bird, he says he knew of several nests within a few miles of Philadelphia. At the present day however, the redheaded woodpecker is not a frequent bird in the vicinity of towns and villages of the regions of which Wilson wrote. At Orange, I never saw more than a dozen individuals in any one year; and all of these, with very few exceptions, were young birds in the fall, found with few or no exceptions, on the edges of heavy timber, and never in orchards or anywhere near the outskirts of villages. I do not speak from very extended experience, but in the course of many pedestrian tours through northern New Jersey and southeastern New York, I never found this bird either common or familiar.

Yet at the west, it has now exactly the habits described by Wilson, frequenting the orchards and coming into the busiest streets of considerable towns with the freedom and unconcern of the warbling vireo and chipping sparrow; indeed, so familiar are they that they frequently alight on the roofs of houses, and tap on the shingles, looking down occasionally, with the utmost *sang froid*, upon the passers-by. Here, if I mistake not, is a gradual withdrawal from certain regions of country, and a change in the habits of those few remaining.

A similar disappearance has taken place, from some localities at least, of the hairy woodpecker. Of this bird I never shot more than a single specimen at Orange, though hunting for it for many years, through quite an extensive range suitable for its habitat. Yet according to Wilson, it was everywhere one of the most abundant and familiar birds in the Atlantic States; an observation indeed, made by other authors, and which I have confirmed myself at several points, yet for some unaccountable reason it has failed to take possession of a considerable region, admirably adapted apparently to his habits; or, if it ever did occupy it, for some equally unaccountable cause, has almost wholly deserted it.

The Carolina parrakeet is another instance of a gradual withdrawal from a former range, the bird rarely appearing now, where formerly it was quite abundant. This may be partially accounted for indeed, by the settlement of the country; the valley of the Ohio, where it was formerly common, having, in the course of half a century, been converted from a wilderness into a thickly settled country. But this explanation is only partially satisfactory; for in its former range are still large tracts of almost primitive wilderness, where it might find every requisite for its existence.

In certain portions of Colorado the raven is now a rare bird where, as the miners have informed me, it was very common, fifteen, or even ten years ago.

Some of these migrations may be easily explained. Many of them occur through human agency; others through climatic modifications. As the settlement of the western frontiers extends, the quail and the prairie hen, finding abundance of food, extend their range correspondingly; and as trees are planted on the plains,*

*A curious question arises here. The vast tract of treeless prairie lying between the Missouri river and the Rocky Mountains, forms at present, a very complete barrier between the sylvan species of the two regions, which they seldom cross; but as the settle-

the insectivorous and arboreal species will become abundant in regions where they previously could not exist. The destruction of forests, and the draining of swamps must, of course, result in the diminution of the numbers of the forest and swamp loving species, as seen very plainly in England at the present day; and again, the protection afforded from predaceous animals, by the presence of man, and the thinning out of birds of prey, must necessarily result in a great increase of the smaller and inoffensive tribes. On the other hand, the persecution to which certain species, mainly rapacious, or valuable for food, are subjected, results in their thinning out or even extermination, unless, as often happens, they migrate to other and wilder regions.

Climate influences many extraordinary migrations. A severe winter will cause northern birds to migrate much further south than usual, and a long hot summer will entice southern birds to visit us, which we do not see in ordinary seasons. Such migrations, however, are only temporary, although I am inclined to think that birds may subsequently revisit regions, purely from choice, to which in the first place, they were compelled to fly for safety. And again, extraordinary seasons may have an indirect influence upon these movements of birds. In a recent interesting little article in the NATURALIST, Prof. Shaler shows how the flora of New England was probably modified by the recent cold winter; and of course, a modification of the flora would result in a corresponding modification of the avi-fauna. Thus, the coniferous trees being reduced in numbers, there would be a similar reduction in the abundance of pine grosbeaks, finches, crossbills, and other species, more or less dependent upon the *Coniferæ* for food. The insect fauna also, closely connected with, and necessarily affected by the slightest change in the flora, must undergo some readjustment, resulting in a corresponding change among the insectivorous birds.

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ment of the plains proceeds and trees are planted, this barrier will gradually cease to exist, and the arboreal faunæ of the Rocky mountains and the east will extend their limits and meet each other. What will be the result on such allied congeneric species or varieties as *Oporornis agilis* and *O. McGillivrayi*, *Sitta Carolinensis* and *S. aculeata*, etc? Will each preserve its characteristics; or will a hybrid race arise, completely merging the one into the other? *Sturnella Ludoviciana* and *S. neglecta*, usually regarded at the present day as varieties of the same species, exist side by side, retaining in a general way at least, certain peculiar notes and habits. On the other hand, *Colaptes auratus* and *C. Mexicanus*, universally admitted as valid species, blend into one another by imperceptible gradations in regions where their habitats adjoin.

In many cases, however, it seems impossible to assign any reason for these irregular migrations. What caused the chestnut-sided warbler to become so abundant in the eastern states, where it formerly was so rare; what influenced the Carolina parrakeet and the raven to desert regions where they were once common; and what caused the appearance of the great-crested flycatcher about Orange, where for years it had not been seen; and why the hairy woodpecker shuns the same region, are questions that will puzzle an ornithologist to answer. Certainly, in none of these cases, was persecution, or lack of proper shelter and food, or change of climate the impelling cause. It may have been the same motive that influenced them, that ofttimes has impelled the races of men to migrate *en masse*, as in the days of the Huns and Goths,—the mere desire to see and possess new countries, with the vague expectation of bettering their condition thereby. Certain it is that, whatever the motive, the tribes of birds migrate here and there, invade and hold new regions, and disappear from others; and move to and fro, upon the face of the earth, in the same manner as do the tribes of men.

DISCOVERY OF AN OCTOPUS INHABITING THE COAST OF NEW ENGLAND.

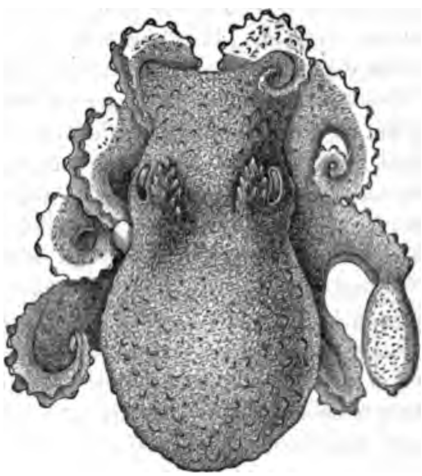
BY PROF. A. E. VERRILL.

One of the most interesting of the numerous discoveries made during the dredgings carried on in the Bay of Fundy last summer, in connection with the work of the U. S. Fish Commission, was a fine new species of Octopus (*O. Bairdii* Verrill) which inhabits the deeper waters of that region. It seems to be not uncommon below seventy-five fathoms, judging from the fact that we met with it in five different localities. All the specimens obtained were males, and it is probable that the females are much larger than the males, as in other species of the genus.

Most of the specimens were kept alive for several days, in order to observe its habits. Several good drawings were made by Mr. J. H. Emerton, showing its different attitudes. When at rest it remained at the bottom of the vessel, adhering firmly by some of

the basal suckers of its arms, while the outer portions of the arms were curled back in various positions; the body was held in a nearly horizontal position and the eyes were usually half-closed and had a sleepy look; the siphon was usually turned to one side and was long enough to be seen in a view from above (Figs. 76 and 77).

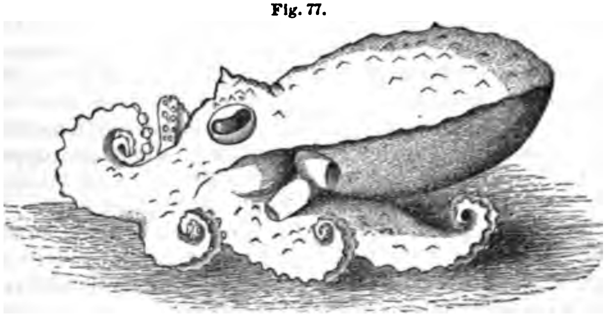
Fig. 76.



Octopus Bairdii. Dorsal view.

When disturbed, or in any way excited, the eyes opened more widely, especially at night; the body became more contracted and rounded, and was held more erect; the small tubercles over its surface and the larger ones above the eyes were erected, giving it a very decided appearance of excitement and watchfulness. It was rarely, if ever, observed actually to creep about by means of its arms and suckers, but would swim readily and actively, circling around the pans or jars in which it was kept many times before resting again. In swimming backward the par-

Fig. 77.



Octopus Bairdii. Side view.

tial web connecting the arms together was used as an organ of locomotion, as well as the siphon, for it and the arms were alternately spread and closed, the closing being done energetically and

coincidently with the ejection of the water from the siphon, and the arms after each contraction were all held pointing straight forward in a compact bundle, so as to afford the least resistance to the motion. As the motion resulting from each impulse began to diminish sensibly, the arms were again spread and the same action repeated. This action of the arms and web recalled that of the disk of the jelly fishes, only it was much more energetic.

The siphon was bent in different directions to alter the direction of the motions, and by bending it to the right or left side, backward motions in oblique or circular directions were given, but it was often bent directly downward and curved backward so that the jet of water from it served to propel the animal directly forward. This, so far as observed, was its only mode of moving forward. This mode of swimming forward has previously been observed in cuttle-fishes (Sepia) and in squids (Loligo). This species was much more active and animated in the night than during the day, and is probably nocturnal in its habits, when at home. None of the specimens could be induced to take food, and none survived more than four or five days, although the water was frequently renewed to keep it cool and pure. They were rather roughly handled by the dredge, without doubt.

The following description is from the "American Journal of Science," for January, 1872:—

"The body is short, thick, somewhat depressed, broadly rounded posteriorly, separated from the head only by a slight constriction at the sides. Head almost as broad as the body, swollen above and around the eyes, concave in the middle above; around the eyes, and especially in front and above, there are numerous small conical, often irregular and rough tubercles; and a little removed from the upper side of each eye is a much larger, rough, irregularly conical, erectile tubercle, which has some small, more or less prominent, conical tubercles on its surface; the whole upper surface of the body, head, and arms is also covered with minute scattered tubercles, which are usually but little prominent. Siphon large, tapering, capable of being bent in all directions, so as to be used for swimming both forward, backward, and sideways, according to its direction. Arms subequal, relatively short, stout, tapering to slender points, connected for about one-third of their length by a web, which extends as a narrow membrane along their margins to near the ends. Suckers small, not crowded, alternating pretty regularly in the two rows; the arms of the first pair each have about sixty-five suckers; those of the fourth pair about sixty. The right arm of the third pair has its terminal portion, for about

a third of its entire length, modified for reproductive purpose into a large spoon-shaped organ, broadly elliptical in outline, with the sides incurved, somewhat trilobed at the end, deeply concave within, where there are nine or ten elevated transverse folds; at the base there is a fold bent into an acute angle, the apex directed forward, leaving a deep V-shaped sinus behind it, which is in continuation of a shallow groove formed by a thickening of the web along the side of the arm and terminating midway between it and the fourth arm; at the end, the arm terminates in a small conical tip, between the two broadly rounded lobes of the spoon-shaped organ; at the base of this organ there is a slight constriction, below which the basal portion bears about thirty-one suckers, like those on the other arms. The modified portion of the arm is considerably longer than the distance between the constriction at its base and the interbrachial web, and equal to one-half the total length of the part which bears suckers. The corresponding arm on the left side is of the ordinary form and has about fifty-one suckers. Length of the largest specimens, in alcohol, exclusive of the arms, 1·75 inches; breadth of the body 1·25; between eyes ·7; length of the arms of the first pair, from mouth, 2·25; from mouth to edge of the web ·70; length of modified portion of third right arm ·70; breadth of this organ when expanded ·45.

When living the color was usually pale, translucent, bluish-white, thickly specked with light orange-brown and dark brown. Off Head Harbor, Campo Bello I., in seventy-five and eighty fathoms, shelly; off Herring Cove in sixty fathoms, muddy; off Grand Menan in one hundred and six fathoms, gravel and sand.

I first dredged this interesting species while on the "Mosswood," in company with Professor Baird, in honor of whom I have named it. It is somewhat related to *O. Grœnlandicus* Dewh., but the male of the latter has the third right arm much longer, with the modified portion relatively very much smaller and quite different in form, and with more numerous folds, and the basal part bears forty-one to forty-three suckers; the other arms also have more numerous suckers; the web is less extensive and the body is more elongated. There is no other species known on the American coast, north of Cape Hatteras. The southern species is very much larger and very different in many respects."

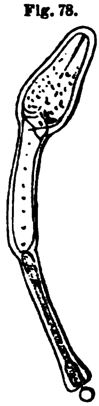
THE HOMOLOGIES OF PEDICELLARIÆ.

BY ALEXANDER AGASSIZ.

O. F. Müller, in his "Zoologia Danica" was the first to point out the existence of certain organs in sea-urchins which have long remained a puzzle to naturalists. To these organs he gave the generic name Pedicellaria, and considered them as parasites of the sea-urchins. Of his genus Pedicellaria he describes three species which are now known to be either different stages of development, or different kinds of pedicellariæ, situated in various parts of the shell of the sea-urchin. Our knowledge of the pedicellariæ is now materially changed, first by the views of Delle Chiaje, who, in 1825, figured and described the pedicellariæ of several sea-urchins and starfishes. He however no longer considers them simple parasites but says distinctly that they form a part of the test of the Echinoderms and help them in seizing their prey and taking hold of adjoining bodies. Much of this view has been corroborated, and like many of the shrewd observations of Delle Chiaje is gaining only now the recognition it should have received long ago. Valentin in 1841 gives in his "Anatomy of Echinus" excellent figures and descriptions of pedicellariæ which he considers as organs of prehension. Agassiz at that time suggested the possibility of their being young stages of Echinoderms, in consequence of the discoveries then made by Sars of the remarkable development of a species of starfish. This, it is needless to say, is a view he has long ago abandoned though he is most persistently credited with it even at the present time. Subsequently, Erdl, Duvernoy, Müller and Troschel, Sars, Stimpson, Norman and Stewart have figured a number of pedicellariæ of Echini and starfishes, and have made a more or less successful attempt to use their characters as aids in distinguishing closely allied species. An article on pedicellariæ in the "Annales des Sciences Naturelles" for 1869, by Perrier, gives a large number of excellent figures of the pedicellariæ of starfishes and sea-urchins; unfortunately, except as a mere accumulation of facts, it is useless, the writer ignoring what had been done for the last twenty years, on the very appendages he was describing, so that he leaves the question of their nature

as it stood in the days of Valentin in spite of the many observations made, and hints of their true nature thrown out by Müller, Troschel, Sars and A. Agassiz, which would have saved Perrier much useless speculation.

Fig. 78.



No attempt has yet been made to ascertain the homologies of these organs, and the present article is intended to give the results which have been reached by the writer since 1864, from the study of the embryology of starfishes and Echini.

Fig. 79.

If we examine the common sea-urchin of the coast of New England, we shall find, scattered in between the spines over the whole surface of the shell, numerous pedicellariæ (Figs. 78 and 79). They consist of a calcareous stem (Fig. 80) articulating at its base upon a small granule of the test; this is surrounded by a muscular sheath expanding into a somewhat swollen portion with a thimble-shaped knob at the end. This knob, though it seems solid and compact at first sight, is in reality split into three wedges (Fig. 81 a), which can be opened and shut at will. When open, these pedicellariæ may be compared to a three-pronged fork, except that the prongs are arranged concentrically instead of on one plane and when closed they fit into one another as neatly as the pieces of a puzzle. Fig. 81 represents the end view of one of these pedicellariæ.

Fig. 81 a.

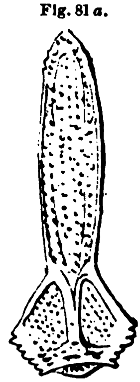
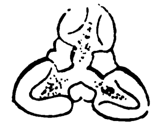


Fig. 80.

If we watch a sea-urchin after he has been feeding, we shall learn at least one of the offices which this singular organ performs in the general economy of the animal. That part of the food which he ejects passes out of the anus, an opening on the summit of the body in the small area where the zones of which the shell is composed converge. The rejected particles, thrown out in the shape of pellets, are received on these little forks which close upon them like forceps, and they are passed from one to the other down the side of the body till they are dropped off into the water. Nothing is more curious and entertaining than to watch the neatness and accuracy with which this process is performed.

Fig. 81.



One may see the rejected bits of food passing rapidly along the lines upon which these pedicellariæ occur in greatest number, as if they were so many little roads for the conveying away of the refuse matter; nor do the forks cease from their labor till the surface of the animal is completely clean and free from any foreign substance. Were it not for the pedicellariæ the food thus rejected would become entangled among the tentacles and spines, and remain stranded there till the motion of the the water washed it away. These curious little organs have other offices besides this very laudable and useful one of scavenger. They occur over the whole body, while they pass the excrements only along certain given lines. They are especially numerous about the mouth where they are much shorter (Fig. 79) and more compact; the muscular sheath below the head is quite short, the tripartite head resting directly upon the limestone rod of the base.

Fig. 82.

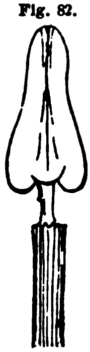
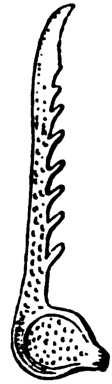
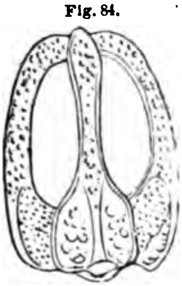


Fig. 83.



On watching the movements of the pedicellariæ we find that they are extremely active, opening and shutting their forks unceasingly, reaching forward in every possible direction, the flexibility of the sheath enabling them to sweep in all the corners and recesses between the spines, and occasionally they are rewarded by catching hold of some unfortunate little crustacean, worm or mollusk which has become entangled among the spines. They do not seem to pass their prey to the mouth (at least I have never succeeded in seeing sea-urchins pass the food thus caught), but merely throw it off from the surface like any other refuse matter. Their mode of eating, also, a sort of browsing, by means of their sharp teeth along the surface of the rocks, does not favor the idea of using the pedicellariæ as forks.

Fig. 84.



Among the different kinds of sea-urchins we find a great many modifications of the pedicellariæ just described. In the genus Cidaris the muscular sheath below the head is short and slender (Fig. 82); it is placed upon the summit of a limestone rod made up of bundles of longitudinal rods. In some Spatangoids the

separate prongs are toothed and ornamented (Fig. 83, *Brissus*). We frequently find, both in the common spherical Echini and in the Spatangoids, the forks forming either open arches, as in Fig. 84, *Echinocardium*, or very complicated ball and socket joints, or independent hemispheres with sharp grooved edges (Fig. 85, *Pourtalesia*). In our flat cake urchin (*Echnarachnius*) the more common pedicellariæ have but two forks, with sharp teeth along the edges (Fig. 86).

Fig. 85.

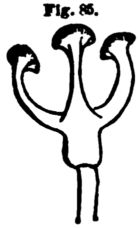
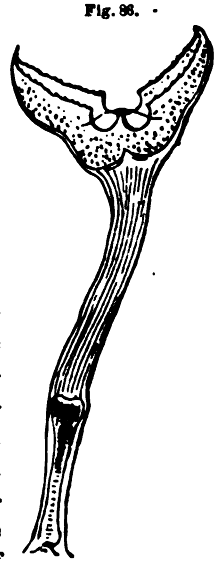


Fig. 86.



In the greater number of starfishes the pedicellariæ are supported upon comparatively short stems, and are as in our common starfish (*Asteracanthion*) clustered round the base of the spines of the dorsal surface (Fig. 87); though in starfishes we also find tripartite pedicellariæ as in sea-urchins, only they are usually supported upon a very short stem, or articulate directly from the limestone network of the shell. We find similarly in Echini pedicellariæ placed in pits (*Goniocidaris*) in which the stem is reduced to a minimum, and their function is quite problematical; their movements are reduced to the mere opening and shutting of the valves. It is from the study of the pedicellariæ of starfishes that we have been able to form some accurate idea of the homologies of these interesting appendages.

Fig. 87.

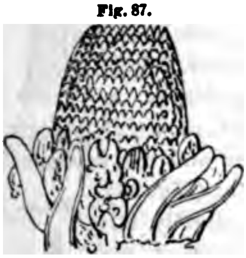


Fig. 88.

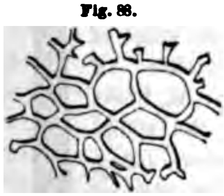
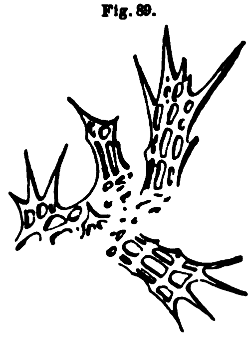


Fig. 89.



We must now go back to the early history of the growth of spines in embryo Echinoderms to obtain the key of the homologies of pedicellariæ. In all young echinoderms the test, *i.e.* the

upper coating of the arms of a starfish, the envelope of a Holothurian, the shell of a sea-urchin, is made up of an irregular network of limestone cells (Fig. 88); with increasing size this network becomes closed at certain points and sends off upright shanks which little by little form very irregular fan-shaped spines (Figs. 89 and 90); in our common sea-urchins these spines are immovable, forming at that stage part of the test itself. As the spines grow they become more pointed (Fig. 91) but are still immovable. In somewhat more advanced stages a slight constriction is formed at the base of the spine (Fig. 92) and very soon after that, below the constriction a tubercle is formed upon which the spine is articulated and capable of a certain amount of motion by means of the muscular sheath connecting the base of the spine and the tubercle, which fit by a ball and socket joint (Fig. 93); soon the spine appears longitudinally striated, the limestone cells of which it was composed when smaller being obliterated by the successive circular layers of the older spine (Fig. 94).

Fig. 90.

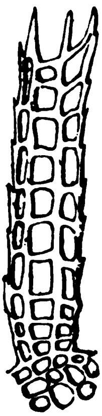


Fig. 91.

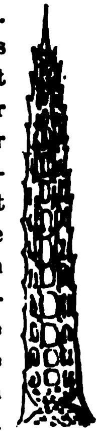
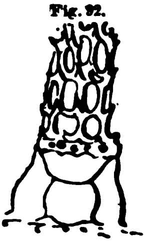


Fig. 92.



In some sea-urchins (*Arbacia*) we find spines which never become articulated, are always fixed, and remind us of the embryonic stage of the spines of our common sea-urchin. In one of the Echini discovered by M. Pourtalès the fixed spines cover the whole upper part of the test (Fig. 95), the movable spines being limited to a circumscribed area along the edge of the shell (Podocidaris).

Fig. 93.

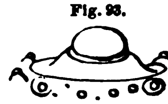


Fig. 94.

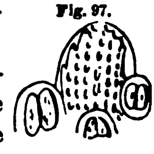
If we trace the development of the spines of starfishes, we find something similar; but as the pedicellariæ are clustered round the base of the longer spines, we are able to distinguish in the earliest stages what will become a spine, and what will eventually form pedicellariæ, a distinction which it is not possible to make in Echini where the pedicellariæ and spines are irregularly

Fig. 95.

scattered. This is especially the case in such genera as Arbacia and the like, in which there are so-called embryonal spines remaining always fixed immovably to the test.

Fig. 96.

Fig. 97.



In our common starfish I have traced the earliest stages of the spines and pedicellariæ (Fig. 96), and have found that at first it is impossible to distinguish between a spine and pedicellariæ; it is only in somewhat later stages that the first trace of a difference can be detected (Figure 97); subsequently there is no doubt whatever, owing to the greater and more rapid development of the central spine, as to what will form spines or pedicellariæ (Figure 98). In one of the pentagonal starfishes of our coast (*Hippasteria*) it is even easier to trace the gradual passage of the original limestone network either, on the one hand, into a spine, or, on the other, into bipartite pedicellariæ.

Fig. 98.

Fig. 99.

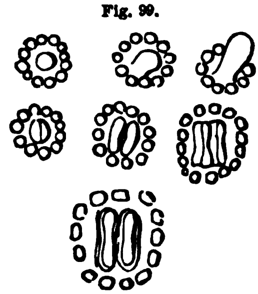


Fig. 100.

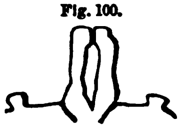
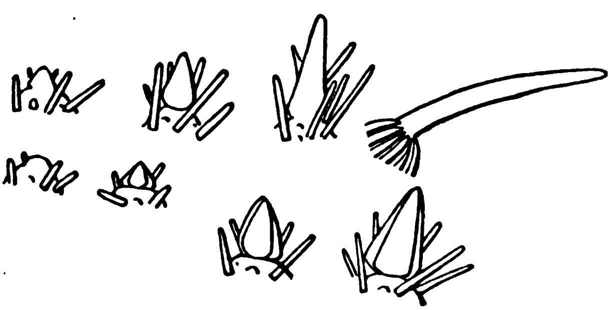


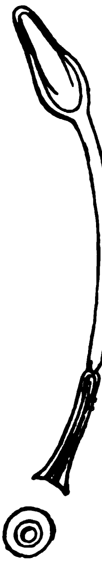
Fig. 101.



In Fig. 99 we can easily trace the development of a simple central granule, surrounded by smaller granules, into a short spine, or by the splitting of the granule we have gradually formed a slight furrow, then a deeper groove, till two clappers are formed

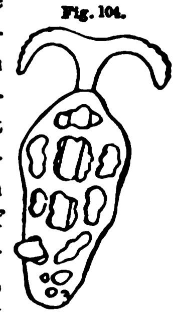
(Fig. 100) which eventually become movable and act as pedicellariæ, though they are the simplest forms of that organ. In another starfish, the genus Luidia, the central granule surrounded

Fig. 102.



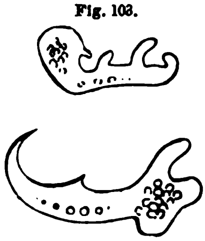
by smaller granules develops either into a spine which passes through the stages of Fig. 101, and terminates in a long slender spine surrounded by papillæ at its base, or the central spine of Fig. 101 is like the central granule of Hippasteria, little by little

Fig. 104.



split into three, and forms finally a passage through such forms as are given in Fig. 101 into short tripartite pedicellariæ surrounded by isolated spines at the base. If anything further were required to prove the homology between spines and pedicellariæ it is the case of tripartite, pedunculated Echini pedicellariæ attached, as common spines are, upon a tubercle (Fig. 93) surrounded by the peculiar smooth area called the scrobicular circle; and this last form of pedicellariæ is actually found in the genus Podocidaris (Fig. 102). The same reasoning will readily suggest to the student of Echinoderms the homology of the so-called claws of Ophiurans (Fig. 103) and of the anchors of Holothurians (Fig. 104) which, although used for such totally different functions, being a sort of prehensile organ, for motion along the ground, are in reality only in their turn modified spines, or different forms of pedicellariæ.

Fig. 103.



Although the spine (Fig. 94) of our common sea-urchin is apparently so different from the pedicellariæ figured in this article, yet when we pass in review the whole order of Echini we find differences among the spines fully as great as those observed in the pedicellariæ. What can be more diverse than the immense, slender, hollow spine of a Diadema six to eight times the diameter of the test, and the short, flattened spine forming a regular pavement on the test of Colobocentrotus. We find such extremes as the club-shaped, curved, ambulacral spines of Salenia, the papillæ of Cidaris, the sharp, solid, curved, antennæ-like spines

of Coelopleurus, the massive, bat-shaped spines of Heterocentrotus, the cupuli-form spines of Goniocidaris, the slender, silk-like spines of the Clypeastroids. Among the Spatangoids, there are several families where the spines are specialized along certain lines (the so-called fascioles) in which they so retain their embryonic features, being either articulated (Fig. 105) or directly attached to the test, and provided at the extremity and along the shaft with a more or less sensitive vibratile membrane, as all young spines originally are.

In Ophiurans we find all the intermediate stages between plates, claws and slender spines; in starfishes between the simplest granules, the most complicated serrated spines and pedicellariæ, and in Holothurians, between mere spicules, anchors and the pavement-like covering of such genera as Cuvieria and Psolus. All this shows plainly enough that the spines and pedicellariæ are strictly homologous, whatever modifications they may assume in the different orders of Echinoderms, whether they serve as prehensile scavengers or simply protect the test against the violence of the waves on the rocks, or the attacks of their enemies. Sea-urchins are favorite food of many species of fish who would find it rather dangerous to attack the bristling Diademas and require pretty strong jaws to get the better of the armored Heterocentrotus. The spines are not simply organs of defence; they also act as means of locomotion, and in such genera as Arbacia the ambulacral suckers perform only a secondary part in the displacement of the sea-urchin, the spines of the lower side serving as stilts by which the sea-urchin raises itself and moves along by a kind of halting gait. In Ophiurans and Holothurians, the pedicellariæ hooks and anchors perform the part of organs of prehension and locomotion at the same time.

Fig. 105.

There is nothing in the history of the development and in the homologies of these organs to show that they have been suddenly brought into existence; on the contrary, the modifications of the spines and pedicellariæ as they have been rapidly sketched in this article show the most complete homology between appendages which have lately been considered as strong proofs of the possibility of the sudden appearance of organs for which no utilitarian motive could be given. I trust I have made it sufficiently plain

that in the most complicated pedicellariæ known, with a freely movable stalk and with snapping jaws, we have only a very gradual modification of the simplest sort of limestone network found in all Echinoderms in the earliest stages of the embryonic development, while still in the Pluteus-stage, and that we have an unbroken sequence from this primitive network to form, on the one side the most diversified spines, and on the other equally variable pedicellariæ, and that we must consider the latter in their most complicated forms as nothing but highly specialized spines.

REVIEWS AND BOOK NOTICES.

THE DEPTHS OF THE SEA.* —One could not but form a favorable impression of this sumptuously printed book from its attractive exterior; the pleasant impression is deepened by a perusal of it. The narrative is on the whole clear and graceful: the novelty of the facts and the fine illustrations will interest the lay reader, and the scientist will find placed before him in an accessible form the results obtained by the British explorations by means of the dredge and thermometer in the depths of the eastern north Atlantic and the Mediterranean Sea.

The marine zoologist will be led after reading it, as perhaps not before, to study more carefully the temperature and chemistry of the water in which he dredges, while the broader questions of the geological and geographical distribution of animals will engage his attention perhaps the more after reading Prof. Thompson's interesting summary of the joint work done by Carpenter, the physiologist and physicist; Jeffreys, the conchologist; and Wyville Thompson, the accomplished zoologist. After the introduction, we have chapters giving an account of the cruise of the "Lightning," those of the "Porcupine;" chapters on deep-sea sounding, and deep-sea dredging, on deep-sea temperatures, the Gulf Stream, the deep-sea fauna, and the continuity of the chalk.

In the introduction (p. 44) the idea is presented that deep-sea

* The Depths of the Sea. An Account of the general results of the Dredging Cruises of H. M. S.S. "Porcupine" and "Lightning" during the summers of 1868, 1869, and 1870, under the scientific direction of Dr. Carpenter, J. Gwyn Jeffreys and Dr. Wyville Thompson. By C. Wyville Thompson. With numerous illustrations and maps. New York and London, Macmillan & Co., 1873. 8vo. pp. 527. (The illustrations are in part here reproduced, thanks to Messrs. Macmillan, the publishers.)

forms dredged around the coast of Great Britain, far from being "boreal outliers," as Forbes designated them, "are the inhabitants of an enormously extended zone of special thermal condi-

Fig. 106.

Dredge with Tangles attached.

tions, which 'crops out' as it were, or rather comes within range of the ordinary means of observation, off the coast of Scandinavia."

We are not so sure but that Forbes' notion was in the main the more correct one. Certainly from the facts presented in this book, we should gather the impression that the circumpolar fauna tended

Fig. 107.

Bathybius Hæckelii.

to fade out, even at great depths off the mouth of the Mediterranean Sea; and the few arctic forms dredged off Florida by Pourtalès are mingled at great depths with a much greater abundance of tropical invertebrate life. But the facts brought out by Pour-

talès in 1867 and '68 are ignored by Professor Thompson, as we shall see farther on.

Fig. 108.

Holtenia Carpenteri.

The idea once so prevalent that animals could not exist at great depths, on account of the supposed great pressure of the sea,

is effectually disposed of by the remark that "the organism is supported through all its tissues on all sides, within and without, by incompressible fluids at the same pressure."

The chapter on deep-sea soundings is full in its details and illustrations, and it is concluded from what has been accomplished

Fig. 109.

Lophohelia prolifera.

by American and English naval officers, that "the central and southern parts of the Atlantic appear to be an old depression, probably, at all events coeval with the the deposition of the jurassic formations of Europe, and throughout these long ages the tendency of that great body of water has no doubt been to ameliorate the outlines, softening down asperities by the disintegrating

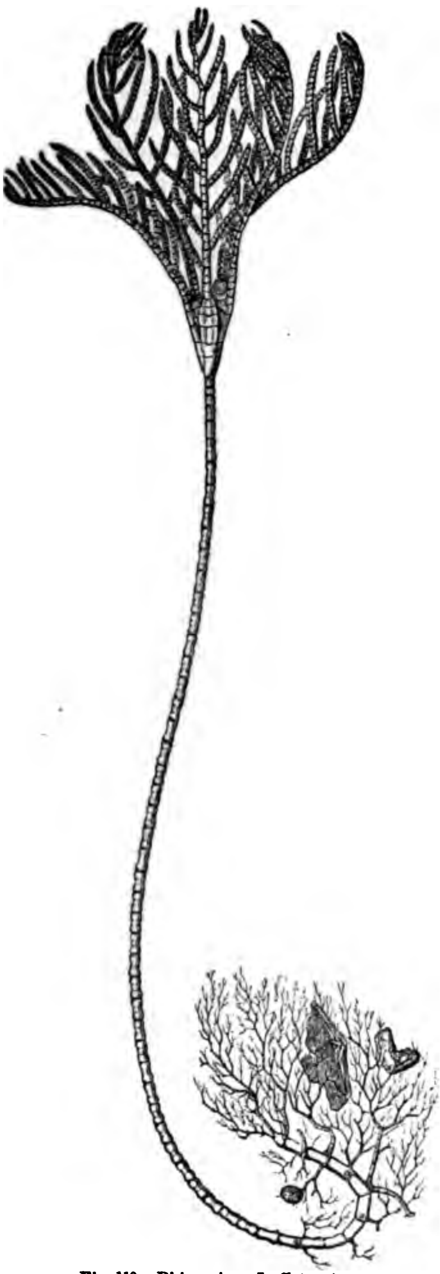


Fig. 110. Rhizocrinus Loffotensis.

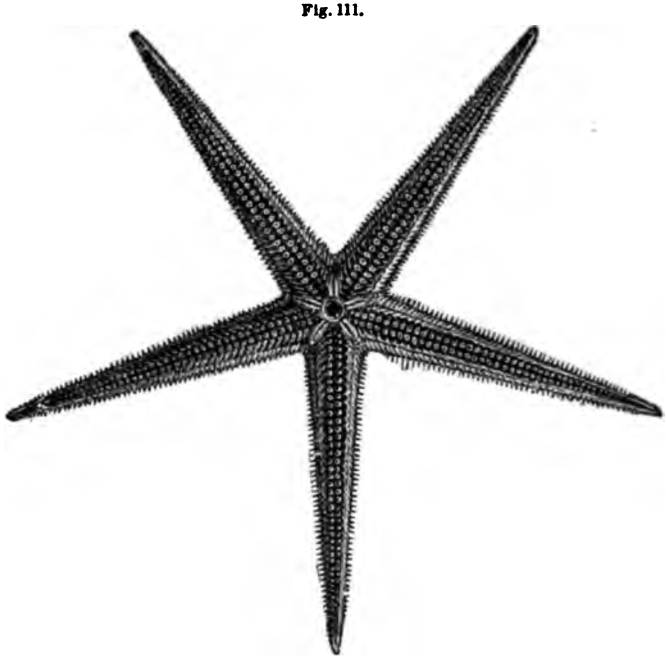
action of its waves and currents, and filling up hollows by drifting about and distributing their materials. . . . . We must regard the Atlantic Ocean as covering a vast region of wide shallow valleys and undulating plains, with a few groups of volcanic mountains, insignificant both in height and extent, when we consider the enormous area of the ocean bed."

The chapter on deep-sea dredging will be found useful and suggestive. We regret to see, however, that in the historical sketch of deep-sea dredging, what had been done previous to British explorations, by Pourtalès under the auspices of the United States Coast Survey is not fully stated. On page 231 of the fifth chapter it is remarked that "dredging operations have been conducted most successfully under Count Pourtalès, and it will be seen hereafter that his results are a valuable complement and corroboration of our own." And on page 277 it is said, "In the year 1868 Count L. F. de Pourtalès, one of the officers employed in the

United States Coast Survey under Professor Pierce, commenced a series of deep dredgings across the gulf stream off the coast of Florida, which were continued in the following year, and were productive of most valuable results."

On turning, however, to the sixth "Bulletin of the Museum of Comparative Zoology," published at Cambridge, Mass., Dec. 26, 1867, we learn that from dredgings off the coast of Florida between May 17th and 29th, and carried to the depth of three hundred and fifty fathoms, Pourtalès concludes that "short as the

Fig. 111.



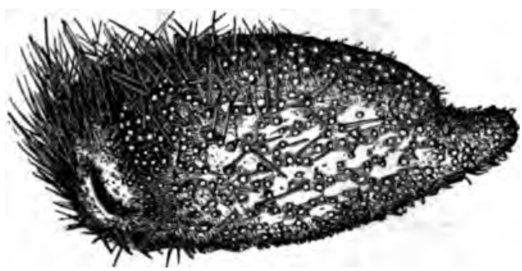
Archaster vexillifer.

season's work was, and few as were the casts of the dredge, the highly interesting fact was disclosed, that *animal life exists at great depths, in as great a diversity and as great an abundance as in shallow water*" (the italics are his).

The work in the spring of 1868 was carried on at a maximum depth of five hundred and seventeen fathoms: thus two seasons' work was accomplished by the United States Coast Survey before the British Steamer "Lightning" weighed anchor at Oban the 8th of August, 1868, for the first British deep-sea dredging voyage.

To the Scandinavian naturalists (particularly Professor M. Sars and his son G. O. Sars beginning with 1850) however, we owe the impetus, which led American and English naturalists to dredge at great depths. Prof. Lovén, however, in 1863, referring to the result of the Swedish Spitzbergen expedition of 1861, when mollusca, crustacea and hydrozoa were brought up from a depth of fourteen hundred fathoms, expresses the remarkable opinion which later investigations appear generally to support, that at great depths, wherever the bottom is suitable, "a fauna of the same general character extends from pole to pole through all degrees of latitude, some of the species of the fauna being very widely distributed." We reproduce (thanks to the publishers) a figure (106) of the dredge with hempen tangles attached, a most valuable

Fig. 112.



Pourtalesia Jeffreysii.

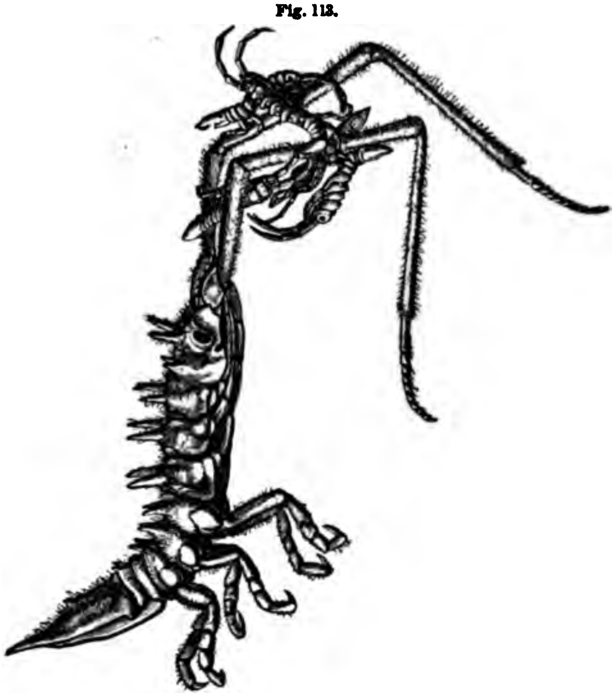
means of fishing up animals such as starfishes, echini and sponges, which the dredge fails to obtain entire or in sufficient numbers.

The exceedingly interesting and able discussion of the origin and relations of the Gulf Stream we must pass over. Our author, however, dissents emphatically from the well known views of his colleague, Dr. Carpenter, on these points. In the account of the deep-sea fauna the *Bathybius Hœckelii* (Fig. 107), which created so much excitement at the time of its discovery, of course is first noticed. Thompson thus speaks of it, "If this have a claim to be recognized as a distinct living entity exhibiting its mature and final form, it must be referred to the simplest division of the shell-less Rhizopoda, or if we adopt the class proposed by Professor Hæckel, to the Monera. The circumstance which gives its special interest to Bathybius is its enormous extent; whether it be continuous in one vast sheet, or broken up into circumscribed individual particles, it appears to extend over a large part of the bed

of the ocean." Fig. 107 is a mass of the protoplasmic material of which Bathybius is formed, with Coccoliths embedded in it, magnified seven hundred diameters.

As an example of the sponges abounding at great depths is the *Holtenia Carpenteri* (Fig. 108, half the natural size). A characteristic coral is the *Lophohelia prolifera* of Pallas (Fig. 109, three-fourths the natural size), which at the depths of three hundred to

Fig. 113.



Arcturus Baffini.

six hundred fathoms "forms stony copses covering the bottom for many miles."

Among the Echinoderms, the *Rhizocrinus Loffotensis* of Sars (Fig. 110, once and a half the natural size) is interesting not only in itself, but as having been found by Pourtalès to occur in the depths of the Gulf Stream off Florida.

The starfish, Archaster, is characteristic of the abysses of the northern seas, and a fine new form is *Archaster vexillifer* W. Thomp. (Fig. 111). A most singular and intensely interesting

sea-urchin is the Pourtalèsia, first found by Pourtalès off the coast of Florida. The British dredgers have revealed a second species (*P. Jeffreysii* W. Thomp., Fig. 112, slightly enlarged). It is closely related to a cretaceous group, the Dysasteridæ. Finally, among crustacea, the sociable *Arcturus Baffini* (Fig. 113, about natural size) with its young clinging to its antennæ is worthy of note as an arctic form.

Many interesting mollusca were obtained, comprising a multitude of new species. Some dredgings in nine hundred and ninety-four fathoms off the Spanish coast revealed "a marvellous assemblage of shells, mostly dead, but comprising certain species which we had always considered as exclusively northern, and others which Mr. Jeffreys recognized as Sicilian tertiary fossils, while nearly forty per cent of the entire number of species were undescribed, and some of them represented new genera." On another occasion in seven hundred and eighteen fathoms off Spain the *Verticordia acutilostata* was taken. This shell "is fossil in the coralline crag, and the Sicilian pliocene beds, and it now lives in the Japanese archipelago."

In the final chapter the doctrine of the continuity of the chalk period with the present is discussed: in other words "that in the deeper parts of the Atlantic a deposit, differing possibly from time to time in composition but always of the same general character, might have been accumulating continuously from the cretaceous or even earlier periods to the present day."

The "Depths of the Sea" is a work that every biologist should read, and for the general student of science it is the only general treatise on this subject. We hope so pleasant and thoroughly educated a narrator as Professor Thompson will be able to favor us with a similar work on the subject, at the close of his "Challenger" cruise. Certainly he will be in a position, if ordinary success attends this important expedition, to give to the world, in connection with American and German observations, results still more comprehensive and conclusive than those flowing from the cruises of the "Lightning" and "Porcupine."

COLOR-VARIATION IN BIRDS DEPENDENT UPON CLIMATIC INFLUENCES.*—The critic's office is not seldom ungracious, and we have

* On the relation between Color and Geographical Distribution in Birds, as exhibited in Melanism and Hyperchromism [*lege* Hyperchromatism]. By Robert Ridgway. Am. Jour. Sci., 3d ser., iv, Dec., 1872, p. 454; v, Jan., 1873, p. 39.

never felt it to be more so than in the present instance; but, having undertaken to keep the readers of the NATURALIST *au courant* with the progress of American ornithology, we shall not shrink from any responsibility this may involve. We recognize Mr. Ridgway's paper as highly meritorious, and a valuable contribution to philosophic ornithology; it is good strong work in a comparatively new field. But until the truths it elucidates are generally recognized and become the common property of ornithologists, it will remain eminently proper to handle the subject not exactly after Mr. Ridgway's method; for he writes as if his views were both novel and original, which is not the case. To speak plainly, the paper is based entirely upon Mr. Allen's views, without the slightest allusion to this author; and is illustrated chiefly by cases already published, yet without the proper references. This is of no consequence to science, in the abstract, and does not detract from the scientific merit of the paper, which lies in its pointed and forcible illustration of certain laws; but in science, much as elsewhere, individual rights must be respected — *noblesse oblige*. In raising an ethical question by our articles of impeachment, we will put the charge of appropriating Mr. Allen's work without acknowledgment into this shape: — *a*, either Mr. Ridgway's views, here enunciated, are original, or, *b*, they are not. If *a*, we acquit him of scientific plagiarism, and accredit him with discovery, but accuse him of suppressing the fact, known to him, that the same discoveries had been already made by another person, and published about eighteen months previously. If *b*, the case speaks for itself too plainly to require further remarks. Mr. Ridgway has been for so long a time an industrious and painstaking student of ornithology that the facts he here elucidates cannot well have escaped his own investigations; and the feeling that he fairly earned his results may have led him to disregard the simple fact that he was anticipated in publication. Without further personal remarks we shall quote the record * in substantiation of what we say; and if we are unjust, or even incorrect in any particular, the pages of the NATURALIST are, of course, open to a refutation of our statements.

The point of Mr. Ridgway's paper is this: a melanistic ten-

* ALLEN, Bull. Mus. Comp. Zool., ii, 1871, No. 3, pp. 229-249. ID., *op. cit.*, iii, July, 1872, *passim*.—COUES, Proc. Phila. Acad., July, 1872, 60.—ID., Key N. A. Birds, Oct., 1872, *passim*.

dency, and a greater brightness, or increased prevalence, of the three primary colors, red, blue, and yellow, "are mainly noticeable as the result of a tropical influence, for they are most highly developed in middle America, and become exaggerated in proportion to the decrease of latitude. But in the Pacific province of North America they are, in many cases, either entirely similar or represented by somewhat modified analogous laws"* (p. 454).

The leading illustration of the *melanistic* tendency selected is the remarkable case of *Chrysomitris psaltria* and its races; this we first worked out in 1866 (Proc. Phila. Acad., 81), exactly as it is here presented, although *C. psaltria* was not then formally brought into the connection, as it has since been by us (Key, Oct., 1872, 132, 133). Mr. Ridgway's next melanistic case is that of *Myiarchus Lawrencii*, of which he has two varieties, the middle American var. *nigricapillus*, and the South American var. *nigriceps*.† Among other similar cases, he cites *Picus villosus* var. *Harrisii*; *P. pubescens* var. *Gairdneri*; and *Sphyrapicus varius* var. *ruber*; the implication being, that such nomenclature, and the views sustaining it, are novel.‡

The first case cited under the law affecting primary colors with "hyperchromism," is that of the *Xanthoura*, § illustrating changes in *yellow*. The next is that of *Myiodioctes pusillus* var. *pileolata* RIDGW. ‖ The case of the genus *Geothlypis* is, however, chiefly employed in this illustration, and a number of interesting relationships, entirely novel, are brought out. The writer is only forestalled here in one instance.¶ In handling the variations in *red*,

*"The increase in color to the southward, especially the tendency to darker tints above shown to be so general. . . . . The southward increase in depth of color, and in iridescence, in birds specifically identical, coincides, also, with the general increase in brilliancy of color, . . . the maximum being reached in the tropics. . . . .

The longitudinal variation, or the westward increase in color, seems to be, also, coincident with the increased humidity to the westward." (ALLEN, 1871, 239.)

"Intensity of coloration varies in direct ratio with the temperature and humidity of the breeding-place." (COUES, Proc. Phila. Acad., July 2, 1872, 60.)

†"*M. nigricapillus* is simply a slight tendency toward *nigriceps*."—COUES, Proc. Phila. Acad., July, 1872, 75.—"Having no doubt that *nigriceps* is simply a geographical representative of *Lawrencii*," etc.—COUES, *ibid.*, 76.

‡*Picus villosus* var. *Harrisii*, ALLEN, Bull. M. C. Z. iii, July, 1872, 180; discussed on p. 114.—COUES, Key, 194.—*P. pubescens* var. *Gairdneri*, COUES, Key, 194.—Under head of *S. ruber*, it is said in the "Key," p. 195:—"Size of the last [*S. varius*]. . . . . of which it is apparently only a variety."

§ Compare *X. Yncas* var. *luxuosa*, COUES, Key, 106.

‖ From the *Muscicapa pileolata* of PALLAS, Zool. R.-A.—Compare BAIRD, Birds N. A., 1858, 293, in text.

¶ *Geothlypis Philadelphia* var. *Macgillivrayi*, ALLEN, Bull. M. C. Z. 1872, 175.

the author employs *Cardinalis*, *Carpodacus* and *Sphyrapicus*; making a new Mexican variety, *carneus*, of *Cardinalis Virginianus*, and following a previous writer * in reducing *C. igneus* of Baird to a variety. In the matter of *blue*, the *Cyanura Stelleri* series is adduced and very skilfully treated. An interesting parallelism of *Stelleri* and *coronata* is elucidated; the writer keeps the two distinct species, although he confesses that they intergrade at one point. The peculiar mode of parallelism is here presented for the first time; the rest of the case is not novel †— E. C.

LATE LOCAL LISTS.—Of three papers of this sort which have reached our table, Mr. Dall's ‡ is the most important, relating to the least known locality. Some of our readers will remember that on a previous occasion we had to speak in high terms of this gentleman's and Dr. Bannister's researches, which resulted in adding many new birds to our fauna. Following up his Alaskan investigations, in connection with the U. S. Coast Survey, Mr. Dall now reports upon 53 species observed in the Aleutian Islands from Unalashka to the Shumagins. "The facts noted are an additional confirmation of the peculiarities of distribution noted by me in previous publications on the fauna of Alaska; and the region visited is of peculiar interest, as being the portion of the West coast where the arctic Canadian fauna of the region north of the Alaskan range, and the characteristic West coast fauna which prevails south of that range, come together and are to a certain extent intermingled." In addition to the names of the species forming the "face" of the report, we have many biographical notes, sometimes extensive, as in case of the kittiwake; sometimes novel, as in the instance of the beautiful Steller's eider, and always interesting. Particular attention has been given to the life-colors of the iris, a matter too often neglected by those whose

* *Cardinalis Virginianus* var. *igneus*, COUES, Key, 151. Also discussed by Allen, July, 1872, p. 114.

† "There appears to be a regular succession of jays of the present group between two extremes of color." BAIRD, Birds N. A., 1858, 583.—"A large series of specimens [of *C. macrolopha*], chiefly from the headwaters of the Columbia, have the front washed with dull blue, and have also the white supra-ocular spot." COUES, Proc. Phila. Acad., 1866, 93.—"Steller's and the long-crested, so much alike that they might be considered as one species; the last named runs into the *C. coronata* of Mexico." COUES, Am. Nat. v, 1871, 770.—"*Cyanura Stelleri* var. *macrolopha*."—ALLEN, Bull. M. C. Z. iii, 1872, 178; COUES, Key, 165, fig. 107.

‡ Notes on the Avi-fauna of the Aleutian Islands, from Unalashka Eastward. By W. H. DALL, U. S. Coast Survey. (From the Proceedings of the Californian Academy of Sciences, printed in advance, Feb. 8, 1873.)

opportunities for contributing this information are both ample and inviting. The nomenclature adopted is not a late one, and many of the species are only nominal, though the competent ornithologist will make the required changes without difficulty in most cases. We note the appearance of a certain "*Hirundo Unalashkensis?* Gmelin"— a species neither identified of late years, nor now determined by Mr. Dall. *Troglodytes Alaskensis* Bd. is properly reduced to a variety of *hyemalis* (*Cf.* Key N. A. Birds, p. 351): but *Melospiza* "insignis," which ought to be similarly treated, stands, as do *Aquila* "Canadensis," *Brachyotus* "Cassini," *Leucosticte* "griseinucha," *Passerculus* "Sandwichensis," *Corvus* "carnivorus," *Pica* "Hudsonica," and many other mere varieties or pure figments. Among interesting occurrences may be noted a second American specimen of *Limosa uropygialis*, lately added to our fauna, and *Moreca penelope*. By this and his previous paper, Mr. Dall has made himself our chief authority on the birds of our newly acquired territory.

With Mr. Allen's late "Reconnoissance," Messrs. Holden and Aiken's paper,* just out, Mr. Ridgway's, for the coming Report, the still unpublished explorations of Dr. H. C. Yarrow and Mr. C. H. Merriam, Lt. Bendire's partially elaborated operations in Arizona, and we may be permitted to add, the whole results of Dr. Hayden's investigations, now in preparation by ourselves — the birds of the interior western territories are getting such an overhauling as they have not had for the past fifteen years. The editor of the Holden-Aiken paper says, "The following interesting notes were prepared for my own private perusal, and not designed for publication. They are possessed of too much interest to be withheld, embodying as they do the careful observations of two promising young ornithologists who have explored, at different seasons of the year, a comparatively new field." The editor is thus responsible for the "get-up" of the paper; and this dovetailing the independent researches of different observers has been done in a way that reminds us of the alleged fact, that Homer nodded once. For we are left in ignorance of, or to find out if we can, the *localities* of observation. "Wyoming and Colorado Territories" cover a good deal of ground, and much of the edge is taken

*Notes on the Birds of Wyoming and Colorado Territories. By C. J. Holden, jr. With Additional Memoranda, by C. E. Aiken. Edited by T. M. Brewer. (From the Proceedings of the Boston Society of Natural History, xv, Dec., 1872, pp. 193-210.)

off the article because we cannot localize the occurrences more precisely. Mr. Holden's observations appear to have been made about Sherman, in the southeast corner of Wyoming, quite a long way from the "Black Hills" as laid down on the maps; while Mr. Aiken's (we understand) were in Colorado, somewhere about Cañon City or Fountain, south of Denver. That our criticism does not lack point may be seen in the fact, that out of 142 species reported upon, only 26 (not one-fifth) are mentioned by both observers; and nearly 100 are given by Mr. Aiken alone. This shows such a radical difference in the faunal characteristic of the regions embraced in the paper, that its two sides would have been presented much better apart; while if merged, the precise locality of observation should have been given in every instance. As it stands, such birds as *Geococcyx Californianus* and *Pipilo mesoleucus* find themselves in ornithological company they never saw outside of a book. The biographical notes are excellent and perfectly reliable. We note with surprise the breeding of *Scolecophagus ferrugineus* in a place (somewhere between the Black Hills, Wyoming and Cañon City, Colorado) where *S. cyanocephalus* would have been expected, and also the occurrence of *Erismatura Dominica* somewhere in Colorado or Wyoming. A new bird, *Junco hyemalis* var. *Aikenii*, is named, but not described, nor is even the authority for the name given. As the page stands, Mr. Aiken is placed in a peculiar predicament of having named a bird after himself. It is not to the point that we, or others, happen to know what the bird is, and who its sponsor is. The name here published for the first time, though it may have been already in type elsewhere, should have been accompanied with a description, or at least a reference. Other nomenclatural points might be criticised. Thus *Cyanura macrolopha* and *Cyanocitta Woodhousei* are certainly not good species: while the impropriety of the name "*Myiarchus Mexicanus*" for the *Tyrannula cinerascens* of Lawrence has been fully exposed by Dr. Sclater, Mr. Lawrence and ourselves.

Mr. Scott's list* "gives the results of about two months of field-work (from the middle of June till the middle of August) on the bird fauna of a portion of Kanawha County, West Virginia. Dur-

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*Partial List of the Summer Birds of Kanawha County, West Virginia; with annotations. By W. D. Scott. Proceedings of the Boston Society of Natural History, xv, Oct., 1872, p. 219.

ing this time 86 species of birds were noted or taken." The writer's work was evidently thorough and searching, and the paper bears intrinsic marks of trustworthiness. We find nothing to criticise, but on the contrary would call attention to several interesting items, notably those relating to the abundance and breeding of *Seiurus Ludovicianus* in this locality, and the occurrence of *Dendrœca Dominica* so far north. The author's views appear progressive, as witnessed in *Parus atricapillus* var. *Carolinensis*.—E. C.

BOTANY.

SUPPOSED AMERICAN ORIGIN OF RUBUS IDÆUS.—Our cultivated raspberry is an importation from Europe. Our native red raspberry, *R. strigosus*, however, is so near it that the specific distinctness has been in doubt; and specimens from British America and the Rocky Mountains certainly occur which a botanist must needs refer to *R. Idæus* itself. In his studies of the European *Rubi*, Prof. Areschoug (in Botaniska Notiser, 1872, and in a translation by himself in Trimen's Journal of Botany, April, 1873, p. 108, etc.) makes prominent and important the fact that *R. Idæus* has no near relative, or in other words is the sole raspberry in Europe, but in mode of growth, in the bark, etc., as well as in the fruit, accords with American species,—with one of them so closely that all who have come to the conclusion that species have a history must needs infer a community of origin. Areschoug concludes, accordingly, that "this species did not originally have its home in Europe, but its origin is to be found in the east of Asia, viz.: Japan and the adjacent countries, or perhaps in North America." It is one of the members of that old boreal flora (as we suppose) now mainly East Asiatic and North American, which has found its way to, or held its place in, the north of Europe somewhat exceptionally. Both *R. strigosus* and *R. Idæus* inhabit Japan and Mandchuria, and Maximowicz regards them as forms of a common species. Prof. Areschoug adopts the now familiar idea "that the Asiatic and North American floras have reciprocally mixed with each other by passing Behring's Straits and the islands which in its neighborhood form a bridge between the two continents;"—which is a partial explanation of a problem that has to be treated far more generally now that we have reason to believe that this flora formerly filled the Arctic zone. He thinks, more-

over, that the simple-leaved frutescent species (also extra-European) are the ancestors of those with divided leaves,— but this is a speculation of a different character, upon which little or no evidence can be brought to bear.—A. Gray *in American Journal of Science.*

Botanical Notelets.—*Equisetum arvense* is characterized as having, and generally has, its branches 4-sided and the teeth four. Milde describes a variety *boreale*, chiefly high northern, with three teeth and 3-sided branchlets. This form is very common around Boston, chiefly in grassy places, and it might in the absence of the fertile plant be mistaken for *E. pratense.* It has been noticed here for some time, but attention has been called to it by Mr. Wm. Boott.

Cypripedium acaule with two flowers has been sent by Mr. J. S. Scott, of Westfield, Mass. The flowers are approximated, the second bract close to and opposite the usual one; and the lips of the two of course facing each other.

Acer nigrum with stipules, at Wabash, Indiana, which Mr. Mills brought to our notice last year, holds the character this season, not only in the tree first observed but in several others.

Anemone nemorosa, or *trifolia.* From the Peaks of Otter, at altitude of about three thousand feet, Mr. A. H. Curtiss sends an anemone of a form new to this country (although there is some approach to it in Oregon), which may be called *A. nemorosa* with undivided leaflets or *A. trifolia* L., according to the botanists' fancy. It is fully as large as the latter, having the stem a foot high up to the leaves, and the leaflets two and one-half inches long; the deepness of the teeth of these, and a slight tendency to trilobation, should rather refer it to *A. nemorosa*, which not rarely exhibits this state in Europe. This European form, as Mr. Curtiss remarks, appears to have kept company with *Convallaria majalis*, being here associated with it in one of the most northern stations of this plant, which in America is restricted to the Alleghanies.

Dimorphism in Forsythia. In Cambridge and its vicinity all the blossoms of *Forsythia suspensa* have long filaments and a short style; all those of *F. viridissima* have short filaments and a long style. This was noticed by Mr. Brown, one of my pupils, of the present Senior Class. In all probability this is not a specific difference, but one of dimorphism. That only a single form of each

species should be met with in this neighborhood, or even in the country, is not extraordinary, since these shrubs are propagated from cuttings or slips. The published figures of *F. viridissima* are of the long-stamened sort. Siebold and Zuccarini describe the long-styled form of *F. suspensa*, the counterpart of the one we have, but their plate represents both; so that the fact of dimorphism is pretty well made out.—A. Gray.

ZOOLOGY.

The Diminution of Food Fishes.—In our recent abstract of the annual report of the Commissioners of Fisheries of this State, reference was made to a letter addressed to the Commissioners by Prof. Baird of the Smithsonian Institution and United States Commissioner of Fish and Fisheries, in answer to one sent by them asking his opinion as to the probable cause of the rapid diminution of the supply of good fishes on the coast of New England, and especially of Maine. The letter is of such an interesting character that we subjoin it nearly entire:—

"We are all very well aware," writes Prof. Baird, "that fifty or more years ago, the streams and rivers of New England, emptying into the ocean, were crowded and almost blockaded, at certain seasons, by the numbers of shad, salmon and alewives seeking to ascend for the purpose of depositing their spawn, and that, even after these parent fish had returned to the ocean, their progeny swarmed to an almost inconceivable extent in the same localities, and later in the year descended to the sea in immense schools. It was during this period that the deep-sea fisheries of the coast were also of great extent and value. Cod, haddock, halibut, and the line fish generally, occupied the fishing grounds close to the shore, and could be caught from small open boats, ample fares being readily taken within a short distance of the fishermen's abode, without the necessity of resorting to distant seas. Now, however, the state of things is entirely different. The erection of impassable dams upon the waters of the New England States, and especially of the State of Maine, has prevented the upward course of the anadromous fishes referred to, and their numbers have dwindled away, until at present they are almost unknown in many otherwise most favorable localities.

The fact, too, has been observed, that with the decrease of these fish there has been a corresponding diminution in the numbers of the cod and other deep-sea species near our coasts; but it was not until quite recently that the relationships between the two series

of phenomena were appreciated as those of cause and effect. Halibut, it is believed, can be reduced in abundance by over-fishing with the hook and line, but the experiences in Europe and America coincide in the confirmation of the opinion that none of the methods now in vogue for the capture of fish of the cod family (including the cod, haddock, pollock, hake, ling, etc.) can seriously affect their numbers. Fish, the females of which deposit from one to two million of eggs every year, are not easily exterminated unless they are interfered with during the spawning season, and as this takes place in the winter and in the open sea (the spawn floating near the surface of the water), there is no possibility of any human interference with the process. Still, however, these fish have become comparatively very scarce on our coast, so that our people are forced to resort to far distant regions to obtain the supply which formerly could be secured almost within sight of their homes.

It is now a well established fact that the movements of the fishes of the cod family are determined; first, by the search after suitable places for the deposit of their eggs; second, by their quest of food. Thus the cod, as a summer fish, is comparatively little known on the coasts of northern Europe; but as winter approaches the schools begin to make their appearance on the northwestern coast of Norway, especially around the Loffoden islands, arriving there finally in so great numbers that the fishermen are said to determine their presence by feeling the sounding lead strike on the backs of the fish!

Here they spend several months in the process of reproduction, the eggs being deposited in January and the fishery being prosecuted at the same time. Twenty-five to thirty thousand men are employed in this business for several months, at the end of which the fish disappear and the fishermen return to their alternate occupations as farmers and mechanics. The fish are supposed to move off in a body to the Grand Banks, which they reach in early summer, and where they fatten up and feed until it is time for them to return again to the northeast. It is believed that the great attraction to the cod on the Banks consists in part of the immense schools of herring or other wandering fish, that come in from the region of the Labrador and Newfoundland seas, and which they frequently follow close in to the shore, so that they are easily captured.

It is well known that the presence or absence of herring determines the abundance of hake and cod on the Grand Manan Fishing Banks, the fishes of the first mentioned family having a peculiar attraction to carnivorous fish of all kinds. It is, however, the anadromous fishes of the coast which bring the cod and other fishes of that family close in upon our shores. The sea herring is but little known outside of the region of the Bay of Fundy, excepting in September and October, and when they visit the entire

coast from Grand Manan to Scituate, for the purpose of depositing their spawn; this act depending upon their finding water sufficiently cold for their purposes, a condition which of course occurs later and later in the season, in going south. A portion of the school indeed passes around Cape Cod as far as Long Island, and I have received them fresh in November, filled with ripe spawn as taken from Vineyard Sound.

In the early spring the alewives formerly made their appearance on the coast, crowding along our shores and ascended our rivers in order to deposit their spawn, being followed later in the season by the shad and salmon. Returning when their eggs were laid, these fish spent the summer along the coast; and in the course of a few months were joined by their young, which formed immense schools in every direction, extending outward in some instances for many miles. It was in pursuit of these and other summer fish that the cod, and other species referred to, came close to the shores; but with the decrease of the former in number, the attraction became less and less, and the deep-sea fishes have now, we may say, almost disappeared along the coast.

It is, therefore, perfectly safe to assume that the improvement of the line fishing along the coast of Maine is closely connected with the increase in number of alewives, shad and salmon: and that, whatever measures are taken to facilitate the restoration of these last mentioned fish to their pristine abundance, will act in an equal ratio upon the first mentioned interest. The most important of the steps in question are the proper protection of these spring fish, and the giving to them every facility needed for passing up the streams to their original spawning grounds; this is to be done, of course, by the construction of suitable fishways and ladders. The real question at issue in regard to the construction of these fishways is, therefore, after all, not whether salmon shall become more plentiful, so that the sportsmen can capture them with the fly, or the man of means be able to procure a coveted delicacy in large quantities and at moderate expense. This is simply an incident; the more important consideration is, really, whether the alewife and shad shall be made as abundant as before, and whether the cod or other equally desirable sea-fish shall be brought back to our coast, so that any one who may be so inclined, can readily capture several hundred weight in a day.

The value of the alewife is not fully appreciated in our country. It is in many respects superior to the sea herring as an article of food; is, if anything, more valuable for export, and can be captured with vastly less trouble, and under circumstances and at a season much more convenient for most persons engaged in the fisheries.—*Boston Daily Journal.*

THE YOUNG ANIMAL AND PROTECTION. — IN the NATURALIST for August last, Mr. Deering advances the well known fact that

the young rattlesnake is not provided with so large or so loud a rattle as the full grown snake, as tending to disprove the mimetic and protective uses of this appendage—"The young requiring greater facilities for obtaining food, and more extensive measures for protection."

Were this accepted as satisfactory reasoning, a similar conclusion might be reached in regard to a multitude of animals, for instance, all those having horns, as the deer, goat, antelope, etc., in which the young are unarmed: yet the protective uses of the horns cannot be questioned. With many of those animals, the female is invariably destitute of these appendages, yet we might suppose, from her position as the immediate protector of her offspring, that she required to be most fully provided in this respect.

The truth is that, to a remarkable extent, the young of most creatures are little else than the food of other animals; often they are the food of even their own species, if not of their own parents. Nothing is more emphatically proclaimed, on every side, than the fact (put into such divine language by Tennyson) that Nature is careless of the individual, however careful she may be of the type. She forms a thousand seeds, but only one germinates and produces its kind. We have, too, the mystery of the pollen, which I have watched for years with wonder, where, in one case, with apparently miserly penuriousness, she doles out the precious life-giving atom just sufficient to fecundate, while, in other instances, as if glorying in her prodigality, she scatters the golden dust as freely as some spendthrift heir squanders the hoarded wealth of his ancestors.

Yet I have perfect faith that "nothing is lost"—nothing wasted; but that all has a governing purpose, circumscribing to the very nicest minutiæ the exact proportion requisite for the result; albeit hidden from our purblind eyes. We know so many of Nature's delicate adjustments and wonderful combinations that, surely, we can have perfect confidence that, even when all is dark to us, her ways are Wisdom's ways. We bring out our clumsy balances, but the volatile aroma escapes us and will not be weighed.

As to the frequency of the young animal not being provided with the protective weapons or appliances of the full grown one, abundant material can be found, from the oyster and lobster, the young

of which are notoriously exposed to destruction, to the noble stag attired with his "branchy crown," rejoicing naturally in his so thoroughly personified gender, guarding the herd of which he is the monarch, or the slow, sullen buffalo, where we see the males forming an impassable cordon around the mother cows and their helpless calves, when assailed by the "cruel archers," the bulls bearing behind their horns the calves when wounded, to a place of safety.

Why the young are unprovided with horns, or even the power to use them, is part of the great plan; and doubtless, may well be considered as tending to prove that at the first, the animal was not so protected, but slowly acquired these weapons through development. The early condition of the horns of the deer covered with smooth velvet, and unsuitable for defence, is another point favoring this view, which is strongly supported by a large amount of corroborative testimony in other animals.

Numberless facts offer themselves on this subject — the protection of the young, and its kindred subject — the precautions adopted to ensure fertilization. The suddenly acquired fierceness of the parent when guarding its offspring is a remarkable episode in the lives of many of the lower animals. This passion, frequently carried to the extreme of rendering them temporarily regardless of personal danger when even their lives are threatened, can only be recognized with wondering admiration;— too often, indeed, it puts our boasted human nature to the blush. This, after all, must be considered as the chief means of protection for the young animal. Though, it cannot be denied, instances are far from infrequent where the parent has the proclivity to devour its offspring.

Among insects the parental instinct is often wonderful, prompting them, not only to defend their young when attacked, but leading them, even in those cases where the parent's life expires previous to the full development of the progeny, to provide for its future, surrounding it with a network of protections, and circumstances adapted to its well-being. — HENRY GILLMAN.

THE WHITE-FRONTED OWL IN CANADA.— Although the "white-fronted owl" (*Nyctale albifrons* Cass.) is now conceded by most if not all American ornithologists to be the young of the saw-whet (*Nyctale Acadica* Bon.), its supposed rarity in comparison with the

adult renders the following record of recent instances of its capture in Canada of considerable interest. Mr. Ridgway, in a paper published in this journal in May, 1872, in noticing Mr. D. G. Elliott's mistake of considering the *N. albifrons* to be the young of *N. Tengmalmi*, has carefully elaborated the evidence of its being the young of *N. Acadica*. This relationship had been previously suspected, and seems now to be fully confirmed. Mr. McIlwraith, under date of Hamilton, Ontario, Canada, Jan. 20, 1873, writes as follows: "On looking over the NATURALIST of April, 1871, I observe a notice of the capture of a specimen of the white-fronted owl in Maine, and the writer of the note, Prof. A. E. Verrill, says that the only other instance of its occurrence in the United States of which he is aware, is the specimen taken by Dr. Hoy at Racine. I am a little surprised at this, for, though not coming much in contact with collectors, I have seen or heard of this species now and then for a number of years back. My first knowledge of it was from Cassin's account, and the figure given of it, in his Birds of America. Shortly afterwards I recognized it in a small case in the possession of the Rev. Professor Ingles, now of the Dutch Reformed Church, Brooklyn, New York, where it was labelled "Saw-whet-Young." The case was brought from Montreal. I next met with it in Toronto, where Mr. Passmore, taxidermist, had two specimens, one of which I obtained and have now in my collection. Again I heard from Mr. P. H. Gibbs, of Guelph, that there were several about his evergreens near the house, one of which he shot. About the same time Mr. Booth, a naturalist of Drummondville, told me of a specimen he had obtained. Dr. Anderson, of Point Levi, opposite Quebec, had his alive for a time, and I heard of still another in the hands of R. K. Winslow, Esq., of Cleveland, Ohio. From the foregoing it would seem to be more common in Canada than it is farther south. The opinion seems to be generally held by those parties with whom I have conversed on the subject that it is the young of the saw-whet, and yet it is somewhat singular that it is not as often met with as its supposed parents. In the month of October, a few years since, I had six in the saw-whet form brought me by a lad who got them all near the same place on his father's farm; yet not one of the other was met with. The theory recently advanced by Mr. Elliott in the "Ibis," of its being the young of the sparrow owl [*Nyctale Tengmalmi*] I do not think at all probable; I have the two side by side

and cannot observe any resemblance to warrant such a conclusion, the difference in size alone being sufficient to show the distinction. My own opinion is that it will be found to be the young of the saw-whet; but is it not possible that they do not all assume the same garb — that there may here be a freak of nature, so to speak, such as there is in the case of the screech owl, where we find both red and gray." — J. A. A.

VARIATION IN THE TARSAL ENVELOPE OF THE BALD EAGLE. — Having observed in Baird's work and elsewhere remarks upon Audubon's plate of the "Washington Eagle," as well as upon his statement, "scutellation on tarsus and toes uniform for their whole length," I have thought that the results of my observations on Nova Scotian eagles may be considered pertinent. I soon found scutellation valueless as a specific character; differing in details in almost every specimen, and often unlike on the two legs of the same specimen. In a series of thirty or forty specimens, I found in some the tarsus crossed in front by five or six large scales; in others the scales successively decreased in size by one-fourth, one-third, and one-half; and in the others again become almost obsolete. The tarsal scutella differ from those of the toes in being immovable in their mutual relations, the phalangeal ones sliding under each other when the toes are extended. There are eleven to thirteen on the middle toe, about eight on the outer, and five on the inner and head toe respectively; they appear to vary less than the tarsal ones do. Now about the figure of "*Haliaetus Washingtonii.*" The bird is drawn standing on a flat rock, which throws the toes forward, causing the tarsal and phalangeal scutellation to *appear* continuous; at least they would so appear, from the point of view presented, unless an engraver were particularly careful. Any bald eagle with well developed tarsal scales would show about the same thing under the same circumstances. Audubon's text is not so easily explained; but as he must have known that it was impossible for the stationary scales of either tarsus or toes to slip so as to meet each other, we may conclude that he meant "scales continuous the whole length of *each.*" But the question of the validity of "*H. Washingtonii*" does not rest entirely upon the accuracy or the reverse, of delineation and description. It is only for a few years that four positive species—*pelagica*, *albicilla*, *leucocephalus* and *Canadensis* have been discriminated

among the mass of "sea," "bald," "golden," "gray," "ring-tailed," etc., eagles stated to inhabit this country. All the gray or brown eagles from Nova Scotia that have passed through my hands are young bald eagles. One measured nearly eight feet across; another 8½ feet; exceeding some balds by over a foot. One had the tail 15½ inches; in another the curve of the bill was 3½ inches, and tarsus the same. These measurements rival and even outdo "Washingtonianus" except in extent of wing.—J. BERNARD GILPIN, M. D., *Halifax, N. S.*

[NOTE. Dr. Coues, to whom we referred this paper, says:—"Dr. Gilpin's remarks upon the variation of the scales are interesting, and may be new to many; while I for one am satisfied with his explanation of Audubon's figure and statement. I wonder how many more times the "Washington Eagle" must be put down before it will stay down! As a species, it is a myth; as a specimen, it was a big, youngish bald eagle — the two-year-olds of which, before getting the white head and tail, are *usually* larger than the mature birds. Of the five eagles given by late authority, the Washington goes under, as just said; *pelagica* is a N. E. Asiatic species, not yet authentically of this country; *albicilla* Greenland and N. European species, *ditto*; leaving *Haliætus leucocephalus*, the bald eagles, always known by naked tarsi; and *Aquila chrysætus* (Canadensis), the gold eagle, with entirely feathered legs, as our only valid authentic species." See Key N. A. Birds, p. 219, 220. — EDS.]

THE COLORADO POTATO BEETLE VARYING ITS FOOD. — A generally received opinion in regard to the Colorado Potato Beetle, *Doryphora 10-lineata* (Say), is that its food is confined to plants of the family Solanaceæ. I have found it this season (June 19, 1872) at Port Austin, Michigan, sparingly feeding on grass, on which it had also deposited its eggs. Later in the season (July 20), at Fort Gratiot, Michigan, I encountered it in large numbers, in both the larva and perfect states, in the vicinity of potato-fields (where it had committed terrible depredations), devouring the younger leaves and flower buds of the common thistle (*Cirsium lanceolatum* Scop.), which it was rapidly stripping even to its thick stem so that the entire top of the plant hung down, almost severed. In the same neighborhood I also saw it on pigweed (*Amarantus retroflexus* L.), hedge mustard (*Sisymbrium officinale* Scop.), the cultivated oat, smart-weed (*Polygonum hydropiper* L.), and the red currant and tomato of the gardens, as well as the common night-shade (*Solanum nigrum* L.), the last two its more legitimate food. But of the last mentioned plants, with the exception of the night-shade, it ate only the young leaves, and of them very sparingly. The thistle it seemed particularly to relish. Could its attention be diverted from the potato to the Canada thistle it would encounter an object worthy of its prowess; and the curses which have

been heaped on its striped back would be turned to blessings. But, I fear, little good can be hoped from the capacity, thus evinced, to diversify its food, and so accommodate itself to circumstances. This can only be regarded as another obstacle in the way of its extermination.

Since writing the above I have found the beetle feeding on the maple-leaved goosefoot (*Chenopodium hybridum* L.), lamb's quarters (*C. album* L.) and thoroughwort (*Eupatorium perfoliatum* L.); and August 8, 1872, I saw it in the larva and perfect states, voraciously eating the black henbane (*Hyosciamus niger* L.), on which was also to be be seen an abundance of the eggs.—HENRY GILLMAN, *Detroit*, *Michigan*, *September*, 1872.

THE SENSES OF SIGHT AND HEARING OF THE WILD TURKEY AND THE COMMON DEER. — At the foot of the bluff on the Vermilion River, I saw a flock of wild turkeys crossing on the ice and coming directly towards me. I concealed myself in a very dense thicket and awaited their approach. Though concealed by the thick brush I knew by the sound, that they were passing very near me, and going towards an open space on the brow of the bluff within easy shot. I rested my gun against a small tree, my head and arms only exposed, intently looking for the appearance of the game. The first that appeared was the head and neck of the leader of the flock, which he seemed to raise above the cover for the express purpose of looking at me, for he instantly stared directly toward me and gave the loud quick note of alarm. In a second or two he, with the rest, took wing, but, as if still in doubt, he flew near enough over me for a better observation. Evidently they did not smell me when they passed. The leader's attention was not attracted by the least motion. Before I had taken down my gun I heard the brush crack, and in an instant a large buck stopped so near me that I could see his form distinctly, but the brush was too thick to justify a shot. He stared at me for some seconds and then, seeming to become reassured, bounded on, when he soon passed through an open space and I shot him.

His attention had evidently been directed towards me by the sense of smell, but seeing no motion his fears became allayed.

The vision of the wild turkey is very acute but the sense of smell is very dull. Exactly the reverse is the case with the deer. — J. D. CATON.

THE ANT-LION.—While in the Indian Ladder Region, Albany Co., N. Y., in August, 1871, I found a large colony of ant-lions. It is situated near the head of the "Ladder Road," at the base of the cliffs and extends for several rods along the path to the "Tory House." The cliffs here hang over the paths, so that it is almost impossible for rain to reach the spot. The soil is composed of disintegrated limestone, extremely fine, but mingled with minute fragments of stone as well as larger pebbles.

In Aug., 1871, the colony numbered rather more than 600 individuals, but on July 6, 1872, there were scarcely half that number. Perhaps at this last date some were in the chrysalis, as of several specimens thus obtained most of them entered that state in a short time, while those taken in August remained until the following spring.

Food was very scarce in this colony, as it was rare to see more than four or five victims in the lions' dens at one time. On several occasions I noticed a strong and active insect, having ventured over the edge of the pit, run swiftly down and up the other side, leaving the ant-lion wildly snapping its jaws, as the intended victim mounted the steep side of the pitfall.

The ant-lion does not, so far as my observation goes, throw up sand to bring down its prey, but throws it up in every direction in order to keep its jaws free to seize the insect when it reaches the bottom of the den.

In 1871 there was another colony (which I did not visit in 1872) near the "Paint Mine." It consisted of some 300 members. I call it a colony, although, of course, there was no friendly intercourse between the inhabitants of the settlement. On the other hand, in the most crowded portions, the chief employment of the insects was to throw out the dirt which their active neighbors were depositing on their own premises.—E. A. BIRGE, *Williams College.*

CLASSIFICATION OF THE COLEOPTERA. — The true classification of insects makes slow but steady progress. Although easily observed, the beetles have not been so well arranged heretofore as in the recent system of George R. Crotch, who proposed to divide the *Coleoptera* into *Rhynchophora* and *Coleoptera* proper, following out the sketch made by Dr. Le Conte in 1862. *Coleoptera* proper in turn are subdivided into two parallel series, the *Isomera* and

Heteromera, characterized principally by the number of the tarsal joints and other characters of less moment; the *Isomera* are again divisible into two parallel series, known generally as *Pentamera* and *Tetramera* though the names are not rigidly exact. The *Pentamera* embrace the bulk of the Coleoptera, and contain all the abnormal tarsal variations; this section was subdivided into five series, the *Adephaga* (second ventral segment visible at the sides); *Clavicornes* (antennæ normally clavate, tarsi variable); *Lamellicornes* (antennæ lamellate, anterior coxal cavities closed); *Serricornes* (antennæ pectinate or serrate, anterior cavities open); Detailed characters were added for the families of *Clavicornes*, which were divided into three main groups characterized by the development of the anterior coxæ, which are prominent and contiguous in *Silphidæ*, etc., globose and separate in *Erotylidæ*, etc., and transverse and separate in *Nitidulidæ*, etc. The families *Rhysodidæ* and *Othniidæ* were removed to the *Adephaga* and *Heteromera* respectively (Proceedings of American Philosophical Society, January 7, 1873).

Do Rattlesnakes Climb trees? — In the attractive volume entitled "The Animal Creation;" by T. Rymer Jones, New York, 1873, we find the author asserting that "they do not climb trees;" but on the preceding page, p. 291, we find the rattlesnake figured as wrapped, constrictor-like, about a good sized tree. The figure itself is poor, and gives the impression of a serpent ten or twelve feet long; but more noticeable is the fact that the text and illustration do not agree. Which is the more correct? On this subject, we have but to say, that we have seen the *Crotalus horridus* crawl up the body of an oak that had grown out from a hillside, in an oblique position. The snake kept his entire length upon the upper side of the trunk of the tree, and finally coiled himself up at the point of departure of the main branches. Here he was partially concealed and had sufficient "room to spare," to dart half his length and seize any bird or squirrel that approached. To this extent, we know that rattlesnakes do climb trees, but not in the manner given in the illustration referred to; and we should judge that Mr. Jones' assertion that they "do not climb" was also incorrect. — Chas. C. Abbott, M. D.

Destruction of Dragon-flies by Birds.—Mr. Gould, in a communication to the Entomological Society of London, says, "I be-

lieve that the larger dragon-flies are very liable to the attacks of birds, and have no doubt that the hobby and kestrel occasionally feed upon them; with regard to the small blue-bodied species (Agrionidæ) frequenting the sedgy bank of the Thames, I have seen smaller birds, sparrows, etc., capture and eat them before my eyes, after having carefully nipped off the wings, which are not swallowed. This must take place to a considerable extent, as I have observed the tow-path strewn with the rejected wings." This has been observed by Mr. J. L. Hersey of New Hampshire (see the following note): — EDS.

BEES AND KING-BIRDS.—For the last ten years I have carefully noted the habits and movements of the king-birds, and have come to the following conclusion, viz: that they do eat the honey bee, and so does the purple martin; but instead of being destroyed for it, they should be protected and allowed to build their nests near the farm-house, because they drive off the hawks, crows and other plundering birds from the poultry yard. Warm afternoons in July and August, when the drone bees are out, we have seen the martins come down within ten feet of the hive and snap up the drone bees, thus relieving the workers from the necessity of expelling them from the hive and biting off their wings to prevent them from getting back to the hive. The king-bird also, we find, selects the drone, and will come afternoons and take his position on a stake in front of the hive, and when a drone bee comes along will make a rush for him, come back to the stake, give him a pick or two and swallow him. But says an objector, "What do they subsist on before the drone bees fly out?" This point I settled by shooting one in the month of May, and I found in his crop the wings and legs of May-bugs. By watching their movements, I find the dragon-fly is also a favorite food for them.— J. L. HERSEY, *American Bee Journal.*

COLOR OF THE EGGS OF CAPRIMULGINÆ.— In the paper of Dr. Elliott Coues in the NATURALIST of June, referring to the eggs of the *Antrostomus Nuttallii*, he speaks of it as a "singular circumstance" that its eggs should be white and adds that it is "a thing before unknown in this genus." In confirmation of his belief in the singularity of the absence of spots in the eggs of Nuttall's whippoorwill Dr. Coues refers to Dr. Sclater's generalization that all *Caprimulginæ* lay colored eggs.

We have in this instance another striking exemplification of the danger of hastily laying down rules from isolated facts. The real fact is, so far as we now know, there are as many species belonging to the genus Antrostomus that lay white unspotted eggs as there are that have colored ones. The eggs of Nuttall's whippoorwill were first obtained by Mr. Robert Ridgway, who met with them, July 20, 1868, among the East Humboldt Mountains, and the unspotted character of their eggs has for some time been a well known and undisputed fact.

But this is not the first instance of the discovery of an unspotted egg of an Antrostomus. In the third volume of the first series of the Ibis, page 64, Mr. Salvin mentions taking, April 20, 1860, on the mountains of Santa Barbara, in Central America, a species of Antrostomus with two white eggs. Mr. Salvin has since informed me that the parent of these white eggs has been ascertained to be *A. macromystax* of Wagler.

So far as we now know two of this genus, *Carolinensis* and *vociferus*, have eggs with purple marbling on a white ground, and two have purely white eggs. Occasionally the eggs of *vociferus* are almost immaculate. It is quite possible that the other southern forms of Antrostomus will be found to have unspotted white eggs and that the markings of the more northern species are the exceptions and not the rule.—T. M. BREWER.

MORE MONSTERS.—The account of a double pig in the June number of the NATURALIST (page 567) leads me to say that there are now in my possession awaiting examination the following malformations.

1. A double pig, apparently identical with that above referred to; the brains are perfectly preserved.

2. A pig more nearly double, the two individuals being joined only by the thorax.

3. A child with two heads, three legs and a rudimentary third arm; of this the viscera including the two brains are preserved.

4. Four calves with two heads each; from two of these the brains are preserved.

5. A cock and a hen full grown, and possessing four legs each.

6. A young chick with one leg.

7. A fœtal pig with seven toes on each manus and six on each pes.

8. The manus of an adult pig with a well formed pollex.
9. A silver fish with partly divided tail.
10. A cat with only one kidney and one cornu of the uterus.
11. A pup, one day old; with no tail, single cloacal opening and one kidney only one-fifth the size of the other.— Burt G. Wilder.

The Depths of Mid Ocean.— In her voyage from Teneriffe to St. Thomas the British Exploring Ship "Challenger" sounded and dredged every other day. The soundings showed that a pretty level bottom runs off from the African coast, deepening gradually to a depth of 3,125 fathoms at about one-third of the way across to the West Indies. If the Alps, Mont Blanc and all, were submerged at this spot, there would still be half a mile of water above them. Five hundred miles farther west there is a comparatively shallow part, a little less then two miles in depth. The water then deepens again to three miles, which continues close over to the West Indies. At the deepest spots both on the east and west side of the Atlantic, the dredge brought up a quantity of dark red clay, which contained just sufficient animal life to prove that life exists at all depths. No difficulty was experienced in obtaining these deep-sea dredgings, and it was merely a question of patience, each haul occupying twelve hours. In depths over two miles little has been found, but that little was totally new.— *Nature.*

A Cat's Jump. — The following statement, of the distance leaped by a cat, is made by the Messrs. Sanford Brothers, of Ithaca, N. Y., who are not only reliable but accurate observers of the doings of animals. "When our cat was about a year old, he was seen on several days to take position upon a show-case four feet high, and to watch a canary in a cage hanging from the ceiling eight feet from the case; the ceiling was eleven feet from the floor; and the cage an ordinary cylindrical one. One day, as we were observing him thus engaged, he suddenly sprung at the cage and caught his claws upon it; his weight swung the cage up against the ceiling, spilling all the vessels, and terrifying the canary; after swinging to and fro several times, the cat dropped to the floor uninjured; we measured the distance from the top of the case to the cage and found it to be ten feet; so that the cat made an ascent of six feet in eight, or upon an incline of nearly thirty-five degrees." — B. G. Wilder.

Œstrus hominis in Texas. — I have in my possession a larva supposed to be that of *Œstrus hominis* Gmelin; if it is not, it is evidently very closely allied to that. It was taken from an ulcer on the shoulder of an eight-year old boy, of our village, on the 15th inst., by his mother, and given to the family physician, Dr. M. H. Oliver, through whose kindness I was put in possession of it. It is a whitish grub, about $\frac{1}{3}$ of an inch in length, somewhat wider than thick, the constrictions between the segments are well marked, the cephalic hooks and anal stigmata are visible. It has the appearance of not being fully grown. It is interesting from the fact that, according to the "American Entomologist," no fly belonging to this family has heretofore been known to attack man within the United States. — S. J. Stroop, *Waxahachie, Ellis County, Texas, January* 22, 1873. [Having received Mr. Stroop's specimen, we may say that this is not the larva of *Œstrus hominis*, but of the sheep bot fly (*Œstrus ovis*), or a closely allied species.—Eds.]

Agricultural Ants.—Mr. Moggridge has observed at Menton, France, two species of ants (*Aphenogaster*) carrying into their nests, during the winter months, the seeds of certain late fruiting plants. He has traced their burrows to a spherical chamber filled with the seed of a grass which he had seen the ants in the act of transporting. "Outside the channels there was generally a heap of the husks of the various seeds, and sometimes one of those heaps would fill a quart measure. These husks had had their farinaceous contents extracted through a hole in one side. He purposely strewed near the nests large quantities of millet and hemp seeds. After the lapse of a fortnight many of these seeds, previously conveyed into the nests, had been brought out again, they having evidently commenced to germinate, and he then found that the radicle was gnawed off from each seed, so as to prevent further growth, and, this being effected, the seeds were carried back again. The cotyledons of germinated seeds were removed from the nest."— *Trans. Entomological Society of London*, 1871.

Metamorphoses of Butterflies. — Dr. Burmeister has forwarded to Paris a fine series of drawings illustrating the earlier stages of the magnificent South American Morphos and Pavonias; many details of their external anatomy are also represented. They will be published in the "Revue et Magazin de Zoologie" and will supply a great deficiency in our knowledge of the metamorphoses of butterflies.

ANTHROPOLOGY.

An Indian Carving.—At a recent meeting of the Essex Institute, Mr. F. W. Putnam exhibited a very interesting carved stone which he had received from Dr. Palmer of Ipswich, who stated that it had been found at Turkey Hill, Ipswich.

This stone was evidently carved with care for the purpose of being worn as an ornament, and was probably suspended from the neck. It is of a soft slate, easily cut with a sharp, hard stone. The markings left in various places by the carver, showing where his tool had slipped, indicate that no very delicate instrument was used, while the several grooves, made to carry out the idea of the sculptor, indicate as plainly that the instrument by which they were made, had, what we should call, a rounded edge, like that of a dull hatchet, as the grooves were wider at the top than at the bottom, and the striæ show that they were made by a sort of sawing motion, or a rubbing of the instrument backwards and forwards. In fact, the carver's tool might have been almost any stone implement, from an arrowhead to a skin scraper, or any hard piece of roughly chipped stone.

Figure 114 represents the stone of natural size, its total length being two and a half inches. It is of general uniform thickness, about one-fifth of an inch, except where the angles are slightly rounded off on the front of the head and on the abdominal outline, and the portion representing the forked tail, or caudal fin, which is rapidly and symmetrically thinned to its edges, as is the notched portion representing the dorsal fin.

Fig. 114.

Carved Stone from Ipswich, nat. size.

The carving was evidently intended to represent a fish, with some peculiar ideas of the artist added and several important characters left out. The three longitudinal grooves in front represent the mouth and jaws, while the transverse groove at their termination gives a limit to the length of the jaw, and a very decided groove on the under side divides the under jaw into its right and

left portions. The eyes are represented as slight depressions at the top of the head. The head is separated from the abdominal portion by a decided groove, and the caudal fin is well represented by the forked portion, from the centre of which the rounded termination of the whole projects. In this part there is an irregularly made hole of a size large enough to allow a strong cord to pass through for the purpose of suspension. The portion of the sculpture rising in the place of a dorsal fin is in several ways a singular conception of the ancient carver. While holding the position of a dorsal fin, it points the wrong way, if we regard the portion looking so much like a shark's tooth as intended to represent the fin as a whole. It is very likely that the designer wished to show that the fin was not connected with the head and, as he was limited by the length of the piece of stone, after making the head so much out of proportion, he was forced to cut under the anterior portion of the fin in order to express this fact. If we regard it in this light, the notches on the upper edge may be considered as indicating the fin rays; but the figure best shows the character of the sculpture, and persons interested can draw their own conclusions.

The symmetry of the whole carving is well carried out, both sides being alike, with the exception that the raised portion at the posterior part of what has here been called the dorsal fin is a little more marked on the left side than on the right, and the edge on the same side is surrounded by a faint, irregularly drawn line.

The carving was unquestionably made by an Indian of the tribe once numerous in this vicinity and, as it was almost beyond a doubt cut by a stone tool of some kind, it must be considered as quite an ancient work of art; probably worn as a "medicine," and possibly indicated either the name of the wearer or that he was a noted fisherman.

Discovery of a New Human Skeleton of the Palæolithic Epoch in Italy.—M. E. Rivière describes (*Comptes Rendus*, 1873, Part 16, 1027) the remains of a second fossil human skeleton from the sixth cave of Baoussé — Roussé (Grottes de Menton), Italy. The skeleton was found at a depth of nearly four metres below the floor of the cave, lying extended on its back in the longitudinal direction of the cave. The deposit forming the floor is regularly stratified, and consists of charcoal, ashes, of small calcined angular stones, bones and teeth of animals, shells and flints. Associated

with the remains were numerous flint implements and a few worked in bone, as well as a number of perforated shells belonging to the genera *Nassa*, *Buccinum*, *Cypræa*, etc.; these, from their position, had evidently formed parts of a necklace and bracelets, and were interred with the body. The extreme friability of the bones did not allow of their removal in so perfect a condition as that of the first skeleton, but, in this case also, they belonged to a tall individual, the skeleton measuring nearly two metres in length. In the débris of the cave, bones of the following animals were met with:— *Ursus spelœus*, *Hyœna spelœa*, *Canis lupus* and *vulpes*, *Arctomys primigenia*, *Lepus cuniculus*, *Mus*, *Equus caballus*, *Sus scrofa*, *Bos primigenius*, *Cervus Canadensis*, *Elaphus corsicus* and *capreolus*, and *Capra primigenia*. Besides there were found some bones of a large eagle and of some birds of passage, as well as numerous species of marine shells of the genera *Patella*, *Pectunculus*, *Mytilus*, *Pecten*, *Dentalium*, and *Trochus*.— *The Academy*.

MICROSCOPY.

Apertures of Objectives.—The full report having been received of the London examination of the Tolles' $\frac{1}{10}$ inch objective sent there for measurement, it appears that unfortunately the examiners were thrown off their guard by an unexpected element in the case, and that, incredible as it may seem, their report does not touch the real question at issue. Everybody knows that an objective with cover-adjustment possesses a certain range of powers and angular apertures; and no one doubts that Mr. Tolles can make an objective of 145° aperture in air, or that the corresponding apertures would be 91° in water and 79° in thinned balsam. The one question in regard to this objective is not its balsam angle at an adjustment, dry, upon an accidentally or arbitrarily chosen object and the corresponding immersion angles, but its balsam angle at its highest (working) adjustment. If, from faulty mounting, the adjustment can be screwed past the limit of good definition, then of course it ceases to be an achromatic objective at all, and its angle beyond such limit is not worth talking about. The examiners do not state, however, that they examined the combination at its highest available angle dry, still less at its highest available angle immersed. Mr. Tolles' prominence as a successful maker of objectives gives a certain value to his statements even when they seem arbitrary; and it is to be hoped that

the secret of his peculiar belief in this case may be fully studied out, notwithstanding the unscientific method which he has chosen, in this instance, of appealing from principles to facts.

The principle involved in this discussion has long been understood. An objective varies in working focal length, and in angular aperture, according to the medium through which it works; and this variation has a definite ratio to the refractive indices of the media compared. By a simple and undisputed mathematical computation, the sine of the semi-aperture in air is to the sine of its semi-aperture in another medium, as the index of refraction of that medium is to the index of air: or, as the index of air is unity, the sine of its semi-aperture in any medium is equal to the sine of its semi-aperture in air divided by the index of the other medium. This theoretical ratio is easily verified by experiment, as instanced by Mr. Brakey in the case under consideration, where an angle of 145° in air should give a fraction over 91° in water and 79° in balsam so thin that its index was an arithmetical mean between that of balsam and that of turpentine, while in hard balsam having an index of 1.549 its aperture would have fallen to 76°. As the angle in air approaches the extreme limit of 170° or upwards, the balsam angle rises so slowly that the above 79° would scarcely reach 83°, the extreme angle for pure balsam being necessarily still smaller. This reasoning assumes only that the extreme ray above the front combination, capable of entering into the image when the objective is worked dry, is the extreme also when adjusted for immersion work.

Mr Tolles has uniformly declined either to accept or to controvert this well known theory, preferring simply to offer proof of his ability to excel this limit, without reconciling such result with the mathematical doctrine. Whether he utilizes rays beyond the extreme ray dry, or whether he measures rays not capable of forming a (good) image he does not state, and we can only conjecture. His early publications seem to claim "collecting" power for more extreme rays; but his letter to the March number of the Monthly Mic. Jour. practically disclaims this doctrine, and hints at a higher refracting power than crown glass has, in the front lens, as the secret of his excessive angle. Curiously this letter happens to be published in the same number with Mr. Brakey's explanation that the result is independent of the quality of the first lens, its index of refraction occurring twice in the computation in such positions as to cancel itself.

Mr. Wenham evidently does not recognize the possibility of "collecting," by means of posterior combinations, rays more divergent (behind the front lens) than those which are extreme when the objective is worked dry; and Mr. Tolles distinctly disavows this theory for his side of the controversy: yet it seems neither absurd nor improbable, and it is most likely the expedient by which the balsam angle is to be increased beyond 82°.

Since the above was in type Dr. J. J. Woodward has published an important contribution on this subject in the Monthly Mic. Jour. A $\frac{1}{10}$ was sent to him in February by Mr. Tolles for examination. It gave good definition, through glass one seventy-fifth of an inch thick, at its point of highest cover-adjustment; but at such adjustment its aperture could not be satisfactorily measured by the tank method. He therefore contrived an ingenious modification of the card-board method, throwing parallel solar rays through the objective from above, and measuring, in a darkened room, the inverted cone of a light below the focus of the objective, by bisecting this cone of light with a thin flat tank filled with balsam or other medium, the objective being attached, immersion fashion, to the surface of the medium. The illuminated portion of the medium was easily seen and measured. This method gave a balsam angle of not over 80° to the $\frac{1}{10}$ sent to him by Tolles for measurement, as well as to other Tolles' lenses previously furnished by that maker. On being apprised of this result Mr. Tolles sent a $\frac{1}{5}$, which gave a balsam angle of 90° to 100°, according to adjustment. This objective was peculiarly constructed, having four combinations instead of three; it could not be worked dry, nor could it work through any but a very thin cover. Dr. Woodward, and Prof. Simon Newcomb and Mr. Renel Keith, who examined the lens with him, attributed the excessive angle to the cause already alluded to, the employment of rays, which if the lens were worked dry would be beyond the limits of transmission, and would therefore suffer total reflection.

Mounting in Balsam.—Mr. W. H. Walmsley's success in mounting objects gives great value to his practical suggestion contributed to Science Gossip. He regrets that beginners should be confronted with spring clips, spirit lamps, and over-heated balsam, when balsam, dried to the point of brittleness and then dissolved to the consistency of rich cream in chemically pure benzole, would obviate the necessity for such annoyances. He frees the speci-

men from moisture by drying or preferably by passing successively through weak and absolute alcohol, treats it with oil of cloves which is more desirable than turpentine because more readily miscible with balsam and not calculated to harden the specimens even if they are left in it for a long time, transfers it to the slide and arranges it with needles, places a drop of the balsam solution on it and applies the glass cover in the usual manner. In a few days the mount will be sufficiently hardened to be handled with safety, especially if after twenty-four hours it should be slightly warmed and the cover carefully pressed down with the forceps and held down with a small weight. The best finish for the edge of the circle he finds to be the same balsam that is used in mounting, laid on with a camel's hair pencil; since this is neat and handsome, and will not spoil the specimen by running in, as may happen with colored varnishes.

UNMOUNTED MICROSCOPIC OBJECTS.—Mr. Jno. H. Martin, of Week street, Maidstone, England, is supplying a great want of microscopists by furnishing unmounted objects for the use of amateurs. His price for two dozen objects, post free, to the United States, is one dollar.

RESOLUTION OF FRUSTULIA SAXONICA INTO ROWS OF DOTS. After my new Tolles $\frac{1}{50}$ immersion had resolved the lines of *Amphipleura pellucida* into beading, I succeeded in obtaining a slide of *Frustulia Saxonica*, mounted dry by J. D. Moller. This test is somewhat easier than the *Amphipleura*, but more difficult dry than *Grammatophora subtilissima* is in balsam, or at least I find it so by lamp light, although both are satisfactorily shown. The following measurements were made with the Tolles $\frac{1}{50}$ objective, No. 2 eye-piece, and camera lucida; amplification 4000 times.

Using an ammonio-sulphate of copper cell and sunlight, the transverse striæ of the *Frustulia* are brought out without the least difficulty. The average number of lines to the thousandth of an inch, in fifteen measurements on different frustules, was eighty-nine. This agrees essentially with the counts of Dippel and Dr. Woodward.

I also succeeded in bringing plainly to view longitudinal lines which were counted in the same way. The average of fifteen counts was ninety-five to the thousandth of an inch. The lowest number observed was eighty-eight, the highest one hundred.

These lines I found more difficult than the transverse ones on *Amphipleura pellucida*, but patent enough to be accurately counted. It appears then that Dr. Woodward was correct in regarding the longitudinal striæ of Dippel as diffraction phenomena, for they were much coarser than the true lines, being as given by him only about 50,000 to the inch.

Thus far everything was done with ease. Then with care the bright apparently raised lines were transformed into rows of beads, this resolution into dots being accomplished in a satisfactory manner.

The results stated above have been repeatedly verified. I also resolve into beads, with the $\frac{1}{50}$, *Navicula crassenervis*, *Striatella unipunctata* and any *Pleurosigma*.— G. W. MOREHOUSE.

MOULD ON BREAD.— Messrs. Rochard and Legros express the belief, in "Comptes Rendus," that this frequent parasitic vegetation is due rather to the poor quality of the flour, or to bad management, than to the presence of germs in the air, and that it may be prevented by adding an excess of salt to the bread.

EFFECTS OF DYEING WOOL.— M. Dumas has been investigating the question whether wool, and similar hairs, are penetrated by the coloring material, or only colored externally in the process of dyeing. In fresh wool he found all the layers perfect; but in bleached wool the outer or cortical layer was marred or destroyed. Fibres dyed with indigo, without boiling, contained granules of the coloring matter between the cells; while hairs which had been boiled in alumina and iron solutions appeared twisted or corroded.

MICROSCOPIC EYES.— In the absence of any further information, and indeed in spite of any possible information, the newspaper story of the boy with microscopic eyes may safely be regarded as a curious hoax, founded on the magnifying power of shortsighted eyes as compared with longsighted ones. One eye may be calculated to form an image twice as large as another eye, or, by an extraordinary deformity, several times as large; but it would be no longer a human eye if capable of giving the high powers of the microscope. That the author of the hoax did not even aim at consistency or plausibility is seen in the representation that the boy was able to use for ordinary purposes the eyes that were capable, unaided, of resolving diatoms.

Economical Value of Raphides.—Mr. F. C. S. Roper suggested to the Eastbourne Nat. Hist. Soc. the value of raphides as tests of the genuineness of certain medicinal substances obtained from plants containing them. Though not new, this method of detecting adulterations or falsifications is capable of a greatly increased usefulness.

Pathology of Malignant Tumors.—Dr. W. B. Neftel, in a contribution to the Archives of Scientific and Practical Medicine, advocates the doctrine that cancer is primarily a purely local disease, due to mechanical or chemical irritation. Thus we notoriously find it usually originating in localities most constantly subject to such causes. Afterwards it becomes generalized by means of the lymphatics and blood vessels, and affects other and distant organs; and the unsuspected promptness with which this takes place occasions the frequent failure of local curative treatment. The existence of a hereditary disposition to malignant tumors, not in the congenital acquisition of morbid germs, but in the inheritance of a faulty structure or arrangement of tissues or organs, which thus offer less resistance to the causes of disease, is not denied, but is believed to have been greatly exaggerated.

Vitality from Germs.—As a reaction from the always fascinating doctrine that organic germs of various kinds, when introduced into the system of larger animals, have a tendency to cause disease and destruction, it has been recently surmised, without attempt at proof, that such germs may actually impart and increase vitality.

Obituary.—Mr. James How, a well known philosophical instrument maker of London, formerly with George Knight and Son, of London, and lately successor to them, died suddenly, Dec. 8, 1872. Mr. How will be remembered for his skill in the use of the microscope, but especially for his prominence among those who took the lead in introducing students' microscopes of good quality and cheap price.

NOTES.

The meeting of the American Association at Portland next month bids fair to be one of the largest held for several years, and we understand that quite a number of titles of papers to be

read have already been entered. A number of the older members of the association, several of whom were unable to attend the western meetings, have intimated their intention to be present, which will add much to the scientific results of the session. The entomologists are also anticipating a full attendance, and anthropology will probably be well represented, while geology and general zoology will unquestionably be maintained in their usual force. Botany has for many years been but slightly represented, to the regrets of workers in other fields. Will not the botanists show their force this year? Section A will probably be largely represented, as heretofore, by many distinguished scientists. Particulars relating to the meeting are given in our advertising pages.

At the late Annual Meeting of the American Academy of Science and Arts, Boston, Prof. Asa Gray resigned the chair of President which he had held for the past ten years. The following officers were elected :— *President*, Hon. Charles Francis Adams; *Vice President*, Prof. Joseph Lovering; *Cor. Sec'y*, Prof. J. P. Cooke, Jr; *Rec. Sec'y*, Prof. E. C. Pickering; *Treasurer*, H. G. Denney; *Librarian*, Edmund Quincy; *Council:* Class I, Prof. Benj. Peirce, Prof. Wolcott Gibbs and J. B. Henck; Class II, Alex. Agassiz, Prof. Asa Gray (in place of Prof. J. Wyman who declined reëlection), and Dr. Charles Pickering; Class III, Rev. G. E. Ellis, Hon. R. C. Winthrop and Prof. A. P. Peabody.

Science in Europe has met a great loss in the recent deaths of Baron Liebig, the distinguished chemist, and of De Verneuil, the French geologist and associate of Sir R. I. Murchison in the geological survey of Russia.

Lastly, who will say that John Stuart Mill, "the greatest living master of the purely inductive philosophy," did not exert an important influence on physical, as well as mental and political science, and anthropology, in its broadest sense?

The U. S. Fish Commission under Prof. S. F. Baird will spend the summer at Peak's Island, Portland Harbor. A large number of students and naturalists will assemble there, and the Commissioner's headquarters will form, as they have in the past, a most important school for the study of biology. A steam-tug has been provided by the government for dredging on an extended scale, and plans are on foot for deep-sea dredging.

THE "Scientific Correspondence" of Goethe was collected by Goethe himself, and will fill two volumes; it comprises the years 1812-32, though most of the letters appertain to 1822–27. There are letters addressed to Goethe by Blumenbach, Carus, Loder, Sömmering, Seebeck, d'Alton, Brandes, von Henning, Martius, Nees von Esenbeck, Purkinje, Wermburg, and Zschokke. It appears from them that Goethe kept up the most lively and detailed interest in the progress of science and natural history until the latest period of his life.— *The Academy.*

IT is with much pleasure that we record the recent munificent donation of one hundred thousand dollars to the Museum of Comparative Zoology made by Mrs. Quincy Shaw, a daughter of Prof. Agassiz. We have never seen a statement of the permanent funds of the museum, but are confident that a dozen or more similar donations would not come amiss, for the expenses of such establishments are much greater than is generally supposed.

WE notice with regret that the aquarial car which was conveying the living fish, oysters and lobsters to the Pacific coast only succeeded in stocking the river at Omaha with such of the animals as survived the fall through the bridge. Query.—How about the strength of the bridges on "the great continental highway?"

THE professorship of Natural History in Ann Arbor, lately vacated by Professor Winchell, has been filled by the election of Professor Eugene W. Hilgard of the University of Mississippi, a gentleman of the highest attainments and especially known in the scientific world from his reports on the geology of the Gulf States.

PROF. N. S. SHALER of Harvard College has been appointed State Geologist of Kentucky, his native state. Prof. Shaler is for the present in England. We learn from the daily papers that he has accepted the situation.

A fine chance is offered to any enterprising naturalist who wishes to test by experiments the theory of cave life, as the present proprietors of the Mammoth Cave offer to sell the cave and all its contents for the sum of $500,000.

THE distinguished botanist Wm. S. Sullivant died at Columbus, Ohio, on April 30th, aged 70 years.

BOOKS RECEIVED.

Transactions of the Massachusetts Horticultural Society for the year 1872. 8vo, pp. 192 Boston, 1873.

Geological Survey of Canada. Report of Progress for 1871-72. 8vo, pp. 154, with maps. Montreal, 1872.

List of Publications of the Geological Survey of Canada. 8vo. pp. 7 Montreal, 1873.

Tidsskrift for populære fremstillinger af Naturvidenskaben. Række 4, Vol. v, No. 1. 8vo, pp. 84. Kjobenhavn, 1873.

Archiv fur Anthropologie. Band V. Vierteljahrsheft 4. 4to. pp. 350-547. Braunschweig, Dec. 1872 *Correspondenz-Blatt der deutschen Gesellschaft fur Anthropologie, Ethnologie und Urgeschichte.* 4to. pp. 65-96. Nos. 9-12. 1872.

Proceedings of the Academy of Natural Sciences of Philadelphia. 8vo. Part III Philadelphia, 1872.

Annual Report of the Board of Regents of the University of Minnesota including the Geological and Natural History Survey of Minnesota, first Annual Report for the year 1872. By N. H. Winchell. 8vo. pp. 167, with maps. Saint Paul, 1873.

Additional Observations on the Dinocerata. By O. C. Marsh. 8vo. pp 4. (From Am. Jour. Sci. and Arts, Vol. V, April, 1873). New Haven.

A Contribution to the Ichthyology of Alaska. By Edward D. Cope. 8vo. pp 9. (From Proc. Am. Phil. Soc., Feb. 17, 1873.)

On the Short-footed Ungulata of the Eocene of Wyoming. By Edward D. Cope. 8vo, pp. 37, With 4 plates. (From Proc. Am. Philos. Soc., Feb. 21, 1873.) Received March 20, 1873.

Catalogue of the Flowering Plants of Vermont. By George H. Perkins, 8vo. pp. 16. (From Archives of Science, Oct., 1872, Jan. and April, 1873.

The Molluscan Fauna of New Haven. By George H. Perkins. 8vo. pp. 55. (From Proc. Bost. Soc. Nat. Hist., Vol. xiii, Oct. 6—Nov. 3, 1869.)

The Mechanism of the Ossicles of the Ear and Membrana Tympani. By H. Helmholtz. Translated from the German by Albert H. Buck and Normand Smith. 8vo. pp. 69, with 12 illustrations. New York, 1873.

Views of Nature and the Elements,—Forces and Phenomena of Nature and of Wind. By Ezra C. Seaman. 12mo. pp 140 New York, 1873.

List of Elevations in that portion of the United States west of the Mississippi River. 8vo. pp. 47. Washington, 1873.

A List of North American Lichens. By Henry Willey, 12mo. pp. 30. Jan. 1873. New Bedford.

Supplementary Note on the Dinocerata. 8vo. pp. 2. (From Am. Jour. Sci. and Arts. Vol. v, April, 1873.

Report on a Second Deep-sea Dredging Expedition to the Gulf of St. Lawrence, with some Remarks on the Marine Fisheries of the Province of Quebec. By J. F. Whiteaves. 8vo. pp. 22. Montreal, Jan., 1873.

On the Action of Rhus venenata and Rhus toxicodendron upon the Human Skin. By James C. White. 8vo. pp. 27. (From New York Medical Journal, March, 1873.)

Notes on the Lingoa Geral or Modern Tupi of the Amazonas. By Chas. Fred. Hartt. 8vo. pp. 20. (From Trans. Am. Philol. Ass., 1872.)

Tidsskrift for populære fremstillinger af Naturvidenskaben. Fjerde Række. Femte Binds. Andet Hefte. Kjobenhavn, 1873.

John Torrey: A Biographical Notice. 8vo. pp. 11. (From Am. Jour. Sci. and Arts, Vol. v, June, 1873.)

First, Second, Third, Fourth and Fifth Annual Reports of the Secretary of the Connecticut Board of Agriculture for 1866, 1867, 1868-9, 1869-70, 1871-2 5 vols 8vo. Hartford.

Notice of New Tertiary Mammals. 8vo. pp. 5. (From Am. Jour. Sci. and Arts, Vol. v. May, 1873. Received May 1st.

Oversight over det Kongelige Danske Videnskabernes Selskabs Forhandlinger og dets Medlemmers Arbeider. No. 3, 1871; No. 1, 1872. 2 pamphs. Kjobenhavn.

Bulletin de la Societe Imperiale des Naturalistes de Moscou. No. 2, 1872. Moscou.

Læren om homogene tunge Vædskers Tryk paa plane Arealer. By Adolph Steen 4to. pp. 541-561. (From Vidensk. Selsk. Skr., 5 Række, Naturvidenskabelig og Mathematisk Afd., ix Bd. 7.) Kjobenhavn.

Bidrag til Kundskab om Egefamilien i Fortid og Nutid. By A. S. Orsted. (From Vidensk. Sel. Skr., 5 Række, Naturvidenskabelig og Mathematisk Afd., ix, Bd 6.) 4to, pp. 335-538. With 8 plates and one map. Kjobenhavn, 1871.

Fifth Annual Report on the Noxious, Beneficial and other Insects of the State of Missouri. By Charles V. Riley, 8vo. pp. 160. Jefferson City, 1873.

Annual Report of the State Geologist of New Jersey for the year 1872. 8vo. pp. 44. Trenton, 1872.

Report of the Entomological Society of Ontario, 1872, *including a Report on some of the Noxious, Beneficial and Common Insects of the Province of Ontario.* By C. J. S. Bethune. 8vo. pp. 73, Toronto, 1873.

On the Strictures of Urethra. By F. N. Otis. 8vo, pp. 20. (Reprinted from the N. Y. Medical Journal, March, 1873.) New York, 1873.

Monthly Report of the Department of Agriculture for March, 1873. 8vo. pp. 131. Washington, 1873.

The Academy. London, May 15-June 2, 1873.

Canadian Entomologist. London. Vol. v, No. 4.

Revue Scientifique. Paris, May 17-June 7, '73.

The Field. London, May 17, 24, 1873.

Land and Water. London, May 17, 24, 1873.

Nature. London, May 15-June 5, 1873.

Bulletin of the Torrey Botanical Club. New York, May, 1873.

American Journal of Science and Arts. New Haven, June, 1873.

Journal of the Franklin Institute. Philadelphia, June, 1873.

Journal of Botany. London, June, 1873.

Popular Science Monthly. New York, July, 1873.

Newman's Entomologist. London, June, 1873.

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PHYLLOTAXIS OF CONES.

BY PROFESSOR W. J. BEAL.

In the summer of 1870 I examined a large number of cones of several species of Coniferæ to see if there was any variation in their leaf arrangement. It has long been well known that the scales or leaves of cones show very plainly a certain number of parallel spiral whorls twisting to the right and a different number twisting to the left. A closer examination will also usually reveal other parallel whorls (one or more in each direction) with numbers differing from those most easily seen. By beginning with the simplest forms of alternate leaf-arrangement, as the elm ($\frac{1}{2}$), and sedges ($\frac{1}{3}$); and then to the more common but more complicated, as the cherry ($\frac{2}{5}$), and American larch ($\frac{3}{8}$), it is found that in these fractions the numerator expresses the number of times we pass around the stem to find a leaf directly over the one with which we started, while the denominator indicates the number of vertical ranks or rows of leaves up and down the stem. This is nicely proven to be true in the case of a fraction with large numerator and denominator in the leaves of *Yucca filamentosa*, where the fraction is thirteen thirty-fourths, if memory is not at fault. In Yucca the bases of the leaves are so broad that they reach about half-way around the stem, so it is easy to see which is below or outside of all the others. The fractions above mentioned also express the angular divergence or show the proportion of the

whole circumference which intervenes between any two consecutive leaves of the same spiral whorl. Stretch a wire or band with marks or appendages so as to be alternate, two-ranked as are the leaves in the elm; then by giving the band a twist, it brings the marks three-ranked, like the sedges; still farther torsion brings them five-ranked, like the leaves of a cherry tree; still more twist and they stand as the scales of the American larch, which is expressed by the fraction three-eighths.

The most common series of fractions found in alternate leaves is $\frac{1}{2}$, $\frac{1}{3}$, $\frac{2}{5}$, $\frac{3}{8}$, $\frac{5}{13}$, $\frac{8}{21}$, $\frac{13}{34}$, $\frac{21}{55}$, $\frac{34}{89}$, etc. The relations of these several numerators and denominators have been repeatedly shown by various authors.

After the first two fractions, each succeeding one may be made by adding both of the previous numerators for its numerator and both of the previous denominators for its denominator. Each denominator is the same as the second succeeding numerator. "Also, taking the orders of secondary spirals nearest the vertical line, on each side, right and left, the number of parallel spirals of the lower order of these two will give the numerator; and this number, added to the number of parallel spirals of the higher order will give the denominator."—*Henfrey*. Also "the number of the parallel secondary spirals is the same as the common difference of the numbers on the leaves that compose them."—*Gray*. These relations enable us to number easily each scale of any cone, or count the spirals each way, and then determine with accuracy the fraction expressing its Phyllotaxis. Balfour and Gray in their text books say the Phyllotaxis is uniform in the same species, and that one direction or the other generally prevails in each species, and that both directions are sometimes met with in different cones of the same tree. Several other text books make the same assertions. Most authors on this subject with which I am familiar say there are only rare cases of other series of spirals. P. Duchartre mentions two other series, viz: $\frac{1}{3}$, $\frac{1}{4}$, $\frac{2}{7}$, $\frac{3}{11}$, $\frac{5}{18}$, $\frac{8}{29}$, etc., $\frac{1}{4}$, $\frac{1}{5}$, $\frac{2}{9}$, $\frac{3}{14}$, $\frac{5}{23}$, etc., and observes that the same relation exists in different fractions of each series as exist in the fractions of the more common series.

Mr. Hubert Airy recently read a paper before the Royal Society, England, an abstract of which is given in "Nature" for March 6, 1873. After mentioning some experiments which show the intimate relations of different fractions of the common series,

he adds: "It also appears that the necessary sequence of these successive steps of condensation, thus determined by the geometry of the case, does necessarily exclude the non-existent orders $\frac{1}{4}$, $\frac{3}{7}$, $\frac{4}{9}$, $\frac{4}{11}$, etc." This conclusion "determined by the geometry of the case," proves to be only an incorrect theory, as shown by the following:

I examined nearly all the cones (one hundred and fifty-five) which grew upon a Norway spruce, seventy-four of which showed five parallel spirals to the right and eight to the left; while seventy-four showed eight spirals to the right and five to the left. Five cones had seven spirals to the right and four spirals to the left. One cone had four spirals to the right and six to the left, and one cone had six spirals to the right and four to the left. I will try to tabulate this and others in a briefer manner:—

NORWAY SPRUCE. . . .	74	Cones	had	5	spirals	to the	right,	8	to the	left.
On Tree No. 1.	74	"	"	8	"	"	"	5	"	"
	5	"	"	7	"	"	"	4	"	"
	1	"	"	4	"	"	"	6	"	"
	1	"	"	6	"	"	"	4	"	"
On Tree No. 2.	18	"	"	5	"	"	"	8	"	"
	21	"	"	8	"	"	"	5	"	"
	1	"	"	4	"	"	"	6	"	"
On Tree No. 3.	5	"	"	5	"	"	"	8	"	"
	19	"	"	8	"	"	"	5	"	"
	1	"	"	7	"	"	"	4	"	"
On Tree No. 4.	23	"	"	8	"	"	"	5	"	"
	17	"	"	5	"	"	"	8	"	"
	4	"	"	7	"	"	"	4	"	"
	2	"	"	4	"	"	"	7	"	"
	1	"	"	4	"	"	"	6	"	"
	1	"	"	6	"	"	"	4	"	"
On Tree No. 5.	34	"	"	5	"	"	"	8	"	"
	44	"	"	8	"	"	"	5	"	"
	6	"	"	4	"	"	"	7	"	"
	3	"	"	7	"	"	"	4	"	"
	1	"	"	4	"	"	"	6	"	"
	2	"	"	6	"	"	"	4	"	"
On Tree No. 6.	63	"	"	5	"	"	"	8	"	"
	53	"	"	8	"	"	"	5	"	"
	1	"	"	4	"	"	"	7	"	"
	6	"	"	7	"	"	"	4	"	"
	4	"	"	4	"	"	"	6	"	"
	8	"	"	6	"	"	"	4	"	"
On Tree No. 7.	9	"	"	8	"	"	"	5	"	"
	13	"	"	5	"	"	"	8	"	"
PINUS PUMILIS.	10	"	"	5	"	"	"	8	"	"
	9	"	"	8	"	"	"	5	"	"
EUROPEAN LARCH. . .	29	"	"	5	"	"	"	13	"	"
	51	"	"	13	"	"	"	5	"	"
	3	"	"	4	"	"	"	7	"	"
	2	"	"	7	"	"	"	4	"	"
	1	"	"	3	"	"	"	6	"	

BLACK SPRUCE.	80	Cones	had	5	spirals	to the	right,	8	to the	left.
Cones for 1869.	65	"	"	8	"	"	"	5	"	"
	3	"	"	4	"	"	"	7	"	"
	2	"	"	7	"	"	"	4	"	"
	1	"	"	4	"	"	"	6	"	"
	3	"	"	6	"	"	"	4	"	"
Same tree in 1870. . . .	26	"	"	5	"	"	"	8	"	"
	23	"	"	8	"	"	"	5	"	"
	2	"	"	7	"	"	"	4	"	"
AMERICAN LARCH. . .	30	"	"	3	"	"	"	5	"	"
	34	"	"	5	"	"	"	3	"	"
	3	"	"	4	"	"	"	6	"	"
	1	"	"	6	"	"	"	4	"	"
	1	"	"	7	"	"	"	4	"	"
	1	"	"	3	"	"	"	4 & 10	"	"

In all of these cases it was possible to see other spirals, but I have mentioned those most apparent in each case. For instance, in the most common forms of Norway spruce, there were spirals with three rows, eight and twenty-one one way, and five and thirteen the other way. Other cones showed three and seven one way, and four and eleven the other.

To cut this article short, the fractions for most cones of Norway spruce was $\frac{13}{34}$, for others it appears to be $\frac{11}{29}$, and for others $\frac{10}{26}$. By operating with the fraction $\frac{11}{29}$ and other numbers of spirals on the cones in the same way as we may on the most common forms, we get this series of fractions, viz: $\frac{1}{4}$, $\frac{3}{7}$, $\frac{4}{11}$, $\frac{7}{18}$, $\frac{11}{29}$, etc. Other cones noticed in the table as having four and six spirals, had also two, ten, and sixteen. The fraction for these was $\frac{10}{26}$, and would be found in a series $\frac{2}{4}$, $\frac{2}{6}$, $\frac{4}{10}$, $\frac{6}{16}$, $\frac{10}{26}$, $\frac{16}{42}$, etc. The latter we observe, when each fraction is reduced to its lowest terms, is the same as the first or most common fractions mentioned. Most cones of the European larch had the phyllotaxis expressed by the fraction $\frac{8}{21}$, others by $\frac{7}{18}$, one other by $\frac{6}{15}$. This latter cone had three, six and nine spirals, and falls into the following series, viz: $\frac{3}{6}$, $\frac{3}{9}$, $\frac{6}{15}$, $\frac{9}{24}$, $\frac{15}{39}$, etc. Most cones of the American larch fall under the fraction $\frac{3}{8}$, others $\frac{4}{10}$, others $\frac{3}{7}$.

In these few examples the same number of parallel spirals is about equally divided in the two directions, right and left. They also show that other series than the one usually accepted as almost universal, are not uncommon, as they may be found on a variety of coniferous trees, though in smaller numbers.

Plants with the leaves opposite generally have them four-ranked up and down the stem, and then the leaves are said to *decussate*. If we start with a plastic stem of this nature we get a fraction $\frac{2}{4}$ to express it; giving the axis a slight twist we get $\frac{2}{6}$, another

twist we get $\frac{4}{10}$, another twist $\frac{6}{16}$, etc. Some of our cones, then, fall into the phyllotaxis of opposite leaves the same as though the stem were more or less twisted. The single cone of the European larch which indicated the fraction $\frac{6}{15}$ (a fraction requiring a division of numerator and denominator by three to reduce it to its lowest terms) falls under decussate whorls of three for its simplest fraction.

I leave any further consideration of this matter showing the relations of the fractions to each other, etc., to those who have a greater skill in mathematics than myself. My examples indicate that we may look for some curious series of fractions by diligently examining the phyllotaxis of a great number of plants of many different species.

It would be interesting to know whether there are any cones which fall into series beginning with decussate whorls of four or more scales.

ON THE DISTRIBUTION OF CALIFORNIAN MOTHS.*

BY A. S. PACKARD, JR.

THE Phalænidæ (Geometrids) of California (including Oregon and Nevada) seem to be composed of four elements: (1) of species of genera exclusively American (North and South). Such are *Chœrodes*, *Sicya*, *Hesperumia*, *Tetracis*, *Azelina*, *Gorytodes* and *Metanema*. Certain species of these, with several of *Tephrosia* (a genus largely found in the New World) are the most characteristic of the Pacific slope of the United States.

(2) The species next most characteristic belong to the following genera: — *Halia*, *Tephrina*, *Selidosema* and *Heterolocha*. Species of these groups occur in Europe, but especially (all except *Halia* which has a species (*H. novaria*) living in northern Europe) in southern Europe, around the Mediterranean Sea, western Asia, and Asia Minor; while species of Heterolocha occur in Abyssinia and South America (Quito).

(3) The next group comprises a few arctic or circumpolar species of *Coremia*, *Cidaria* and *Larentia*, or of cosmopolite genera

* Extracted from a communication presented to the Boston Society of Natural History, May 7, 1873.

such as *Hypsipetes*, *Cidara*, *Coremia*, *Eupithecia*, *Scotosia*, *Acidalia* and *Boarmia*.

(4) There are four species common to both the Pacific and Atlantic states, viz., *Larentia cumatilis*, *Camptogramma gemmata*, *Tephrosia Canadaria* and *Azelina Hübneraria*.

In the brief introductory remarks to the first part of this Catalogue (these Proceedings vol. xiii, 381) we briefly alluded to the fact that some Californian Lepidoptera repeat certain features peculiar to the fauna of Europe. I find that there are but two forms strikingly European among the Phalænidæ, viz., *Numeria Californiaria* Pack. (wrongly described by me as *Ellopia Californiaria* xiii, p. 384) which is very near the European *Numeria pulveraria*, and quite different from the Atlantic states *N. obfirmaria*, and the genus *Chesias* which does not, so far as yet known, occur in the Atlantic region.*

But if we find a very few species which recall the European fauna, there are on the other hand many peculiar European genera which do not occur in the Pacific region. In other groups of Lepidoptera there are some species that recall European types; such, especially, are *Papilio Zolicaon* Boisd., representing the European *P. Machaon*, and the genus *Parnassius*, which does not occur in the Atlantic region.

Going out of the Phalænidæ, we find a few European types of Bombycidæ which occur in California and are not found in the Atlantic states, such as the genera *Epicallia* and *Callarctia*.

On the other hand we find in California no such development of the genus *Lithosia* as in Europe, no species of *Zygæna*, no *Psychidæ* (except *Phryganidia*, an aberrant form); no such development of *Hepialus*, while *Xyleutes robiniæ*, as in the Atlantic states, represents the European *Cossus ligniperda*; moreover the various forms of *Lasiocampa* and other allied genera are far less numerous if not (*L. Carpinifolia* Boisd. is, according to Grote, a species of Gastropacha) quite wanting in the Pacific region.

We miss again in the Pacific states any species of *Telea* or *Tropæa*, forms linking the Atlantic or northeastern American entomological fauna with that of northeastern Asia (*Telea* being represented by the closely allied *Anthæræa* and *Tropæa Luna*

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* I also referred to a supposed species of *Rumia*. On further examination I find that this and the Maine species are types of a genus, different though allied to *Rumia*, and accordingly in the present paper call it *Hesperumia*.

being represented by *T. Selene* Leach). California has evidently not borrowed her insect fauna from northern China or Japan.*

In the Neuroptera we have strong European features, the genus *Rhaphidia*† occurring in the Pacific states, and not in the Atlantic, while *Boreas Californicus* is more like the European *B. hyemalis* than our two Atlantic species.

The crustacean fauna of northeastern America, with Limulus as its most remarkable feature, repeats that of eastern Asia; but on the other hand Dr. Hagen states that the European genus Astacus occurs in California, while Cambarus is only found east of the Rocky mountains.

Mr. F. W. Putnam informs me that of one hundred and seventy-three genera of fishes given by Günther as inhabiting the seas about Japan, only about thirty-six are represented on the northwestern coast of America, and of these thirty-six the majority are also found in the Atlantic, while about eighty others of the Japanese genera are also represented on the southeastern coast of North America and in the West Indian seas, of which a number are found on the western coast of Central America as well. He also tells me that the fresh water fishes of northern Asia, when compared with those of other regions, more nearly resemble those of the northeastern parts of North America, though a number of the genera are also common to both North America and Europe. By the same authority I am informed that there is a striking resemblance between the reptiles and batrachians of northeastern Asia and northeastern America.

My attention has been drawn to a consideration of these features in the geographical distribution of animals by a perusal of the able and suggestive essay by Prof. Gray on the distribution of California plants, in his address at the Dubuque meeting (Aug., 1872) of the American Association for the Advancement of Sci-

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*Dr. Boisduval, who was the first to publish a lepidopterous fauna of California enumerates the following species of Lepidoptera as being common to California and Europe:— *Vanessa Atalanta*, *V. cardui*, *V. Antiopa*, *Chelonia caja* and *C. Dahurica*, *Arctia* [Phragmatobia] *fuliginosa*, *Gonoptera libatrix*, *Phlogophora metriculosa*, *Amphipyra pyramidea*, *Agrotis exclamationis*, *A. annexa*, *A. saucia*, *A. fumosa*, *A. ravida*, *Cucullia asteris*, *C. lucipara*, *Plastenis subtusa* Fabr., *Noctua triangulum*, *N. plecta*, *Hadena pisi*, *H. protea*, *Monogona Hormos*, *Plusia festucæ*, *P. questionis*, *P. ni*.

These are scarcely more distinctive of Europe than of America, some of them being common to the subarctic regions of the two continents, and others may yet prove to be distinct from the European species.

†Rhaphidia has as yet only been found in Europe, northern Asia, and western North America (MacLachlan).

ence, and of Mr. Lesquereux' able papers in Hayden's Geological Reports on the Territories, 1872. The main features in the geographical distribution of land animals are apparently the same with those of plants. Prof. Gray shows that "almost every characteristic form in the vegetation of the Atlantic States is wanting in California, and the characteristic plants and trees of California are wanting here" (*i. e.*, in the Atlantic States). We may on the whole say of the Californian Lepidoptera, at least, as Dr. Gray remarks of the plants, that they are "as different from [those] of the eastern Asiatic region (Japan, China and Mandchuria) as they are from those of Atlantic North America. Their near relatives, when they have any in other lands, are mostly southward, on the Mexican plateau. . . . The same may be said of the [insects] of the intervening great plains, except that northward and in the subsaline [insects*] there are some close alliances with the [insects] of the steppes of Siberia. And along the crests of high mountain ranges the arctic-alpine [insect-fauna] has sent southward more or less numerous representatives through the whole length of the country" (p. 10). He then refers to the "astonishing similarity" of the flora of the Atlantic United States with that of northeastern Asia. Our actual knowledge of the insect species of northeastern Asia is most vague compared with the exact knowledge of the botanist, and the comparison we have drawn relates only to generic types.

It is evident that the notion of continental bridges in quaternary times, connecting for example Asia and California, is quite unnecessary, since there are, so far as is yet known, no forms characteristic of Asia in the Californian fauna, and the grand difficulty is to account for the presence of a certain resemblance to

*Dr. Leconte has noticed the similarity of our saline-plains beetles, containing so many species of Tenebrionidæ, to the fauna of the deserts and steppes of Asia. (Proc. Amer. Assoc. Adv. Sci., 1851. Albany meeting, 252.) He also states that "the only manner in which the insect fauna of California approaches that of Europe, is in the great abundance of apterous Tenebrionidæ. But in this respect it does not differ from a large part of South America; and by the very form of these Tenebrionidæ, which bear no resemblance at all to those of Europe, the greater relation of the Californian fauna to that of the rest of America is clearly proved." Andrew Murray (on the Geographical Relations of the chief Coleopterous Faunæ, p. 36, 1871) also refers to this fact; the genus *Elodes* in California replacing the genus *Blaps*. He adds: "other Heteromerous forms, reminding us of Mediterranean and Asiatic species, occur in California, and the whole of the northwest of America has a greater preponderance of the microtypal stirps than perhaps occurs east of the Rocky Mountains." I should add that Mr. Murray in explaining the term *microtypal*, states that "the fauna and flora of our own land [Great Britain] may be taken as its type and standard."

the European fauna in that of California. Here I think Dr. Gray has been the first to indicate a solution of the problem. Our knowledge of American fossil tertiary insects is at present almost *nil;* we must, then, in the absence of any evidence to the contrary, follow the conclusions of Gray with the later confirmation of Heer and Lesquereux.

The ancestors of the Californian *Parnassius*, *Rhaphidia* and other European forms, may have inhabited the Arctic tertiary continent, of which Greenland and Spitzbergen are the remains, and their descendants forced southward have probably lost their foothold in the Atlantic region and survived in California and Europe, like the Sequoia in California. Something more than similarity of climate is needed to account for the similarity of generic forms; hence community of origin, with high antiquity and a southward migration of forms not of tropical origin, are the factors needed to work out the problem. That something of this sort has taken place in marine animals we know to be the fact. Certain forms now supposed to be extinct on the coast of New England and Scandinavia, such as *Yoldia arctica* Gray (*Nucula Portlandica* Hitchcock), are still living in the seas of Greenland and Spitzbergen. The quaternary fauna of Maine indicates a much more purely arctic assemblage than is at present to be found. This is also the case with the Scandinavian quaternary fauna, according to the researches of Prof. M. Sars. As we have before shown, the circumpolar marine fauna runs down along the coast of northeastern America and of Europe, and the forms common to the two shores have not come one from the other. Europe has not perhaps borrowed in quaternary times from America, but both have been peopled from a purely circumpolar fauna. If there has been any borrowing it has been on the part of Europe, since the fossil musk ox of France and central Europe is said to be identical with the musk ox of arctic America. So also on the coast of northeastern Asia and Alaska are circumpolar forms, which have evidently followed the flow of the arctic currents down each coast. The forms which are identical or representative on these two coasts are forms derived from the circumpolar fauna; so the forms which are so strikingly similar in northern Japan to those on the coast of New England are, if we mistake not, also derived from the northward. I believe it to be a matter of fact that the Atlantic States species of insects which are common to the two countries,

are, if not of circumpolar, at least of subarctic or boreal origin. From these facts we are led to accept the conclusions of Lesquereux and Gray that co-specific or congeneric forms occurring in California and Europe and Asia, are the remnants of a southward migration from polar tertiary lands during tertiary and even perhaps cretaceous times; and in proportion to the high antiquity of the migrations there have been changes and extinctions causing the present anomalies in the distribution of organized beings which are now so difficult to account for on any other hypothesis.

For this reason it is not improbable that those species of insects which are more or less cosmopolite (and independently so of human agency) are the most ancient, just as some forms taxonomically the most remote are remnants of earlier geological periods. For example, the curious anomalies in the geographical distribution of *Limulus*, the genus only occurring on the eastern coasts of Asia and North America, accord with its isolation from other crustacea. Geological extinction has gone hand in hand with geographical isolation. It was a common form in Europe in the jurassic period, and in the next lower (permian) period but one (the triassic intervening) we find other Merostomata and a few Trilobites.

We make these speculations hoping that much light will be thrown upon the subject by studies on the rich tertiary insect beds of the west, and of the fossil insects in the arctic tertiary and cretaceous formations. Until then we must regard all foundations for these hypotheses as laid by the fossil botanist.

ON THE STATUS OF ARISTOTLE IN SYSTEMATIC ZOOLOGY.

BY THEODORE GILL, M.D., PH. D.

Such extravagant claims have been urged in favor of the recognition of Aristotle as an exponent of classificatory science, and as a model meet to be followed by the naturalists of the rising generation, that it may be timely to inquire into the merits of such claims, and whether they are really justified by his works. In doing so we must, of course, in justice to the ancient author, exclude from con-

sideration the results of accumulation of data by various workers, which have culminated in the recognition of the valuation and subordination of groups now prevalent, and limit ourselves to the inquiry whether there was aught, either in the spirit or the method of inquiry exhibited in Aristotle's works, or in any of his conclusions, far in advance of his own age and transcending (as has been urged) even the fruits of the researches of Linné and later writers. And inasmuch as the mammals are the best known, and most familiar to the naturalist as well as layman, the treatment of the members of that class may be examined, and it may be regarded as tolerably certain that if ill fortune has resulted in their case, it has, to even a greater degree, in others: and, as a matter of fact, such has resulted in other cases, but the reader will have to take for granted that the writer has satisfied himself of the fact. If the statement should be gainsaid, he is prepared to prove the truth of the assertion; meanwhile, proof is only offered affecting the classification of the mammals. The references to the book, chapter, and paragraph where are found the assertions commented upon, will enable verification (or correction) to be readily made. The principal claims in behalf of Aristotle affecting the mammals are the following:—

1st. The complete and scientific recognition of the class as now limited.

2d. The recognition of relations based on scientific induction and knowledge of homologies.

3d. The recognition of natural groups (families, orders, etc.) as now understood.

4th. The appreciation of the principles of classification; or, in other words, the subordination of values of such groups.

These may be examined in the order enumerated.

1. Recognition of the class. It has been urged that the full recognition of the class of mammals was attained by Aristotle; that, in fact, "The Zootoka of Aristotle included the same outwardly diverse but organically similar beings which constitute the Mammalia of modern naturalists."*

It is quite true that all the mammals were recognized as Zootoka (or viviparous), but so were other animals, and the adjective was not restricted to the mammals. In reference to reproduction, Aristotle has simply remarked, as matters of ordinary observation,

*Owen (R.) On the classification. . . of the mammalia. . . 1859, p. 1.

that animals are viviparous, oviparous and vermiparous. Such a distribution would naturally occur to one who had observed a number of facts, but very little scientific knowledge would suffice to correct the erroneous first impression.

Further, among the viviparous animals are included man, the horse, the seal,* and others with hair; and among marine animals the cetaceans, but so are also the *Selachians* (I, iv, 1) and, in another chapter (I, vi, 2), the viper is added. He makes, it is true, a distinction between such as are *internally* viviparous and oviparous (I, iv, 2) for he had not conceived of the possibility of the truth embodied in the aphorism "*omne vivum ex ovo*" but there is no evidence that he had any conception of the significance of the character observed, or that if called upon to subordinate the groups of animals, he would have classed them otherwise than ordinary observers of the same facts would have done and, in numerous cases and with knowledge of the same facts, did afterwards: it is at least, an assumption which is even negatived by other observations of Aristotle, and rendered improbable by our knowledge of the operations of the mind exhibited by others in the classification of facts.

If, on the one hand, Aristotle appears to recognize, in the statement that the Selache are viviparous fishes (VI, x, 1), that the Cetaceans are not fishes, but a peculiar group (I, vi, 1) like birds and fishes; on the other hand, by direct association of them with Selachians as viviparous aquatic animals (VI, xi, 4) and their contradistinction from viviparous animals with feet and from man, as well as from the oviparous fishes, he removes them to a still greater extent from the ordinary mammals † and raises a doubt what really were his ideas as to their relations.

2. Recognition of homologies.—Although recognizing homologies in a vague manner (I, i, 3, 4), as any one capable of thinking and expressing his thoughts must do to a greater or less extent, his appreciation rarely advanced much if at all beyond the popular views, and he frequently confounded the relations of true homology and analogy, putting, *e. g.*, in the same category, the relation of the nails and hoofs of ordinary quadrupeds and the nails of the

* The seal, in another place (where it is also said to have cartilaginous bones) (VI, xi, 3), was associated with the cetaceans, as were also the sawfish (Pristis) and βοῦς (Ceatoptera?) (VI, xi, 1.)

† Oviparous vertebrates are interposed between the two categories.

human hand, and crabs' claws (I, i, 4). Deceived by the inclusion of the proximal joints of the members within the common abdominal integument and the elevation of the heel and carpus, in most mammals, he adopted the current view that all animals, except the elephant, differed from man in the contrary flexures of the limbs, having the joints of the fore limbs (really the carpus) directed forwards and those of the hind limbs (tarsus) directed backwards (II, i, 4). His observations of monkeys, which would have enabled him to add other exceptions to the elephants, were even forgotten for the time being in these "generalizations." *

A still more evident failure to appreciate correlation of structure is exhibited in the statement that the lion has no vertebræ, but only one bone in the neck (II, i, 1), and yet no one — certainly no one habituated to comparison of things — could look upon that animal without perceiving the likeness to the cat,† and it might also be supposed that the very movements of the beast, or natural deductions concerning them if it had not been seen alive, based on the knowledge of the necessities of animal life and animal mechanics, might have prevented the reception of such strange ideas.

3. Appreciation of groups.— Among the multifarious objects of which the sense of sight takes cognizance, there are many so much alike that they are at first naturally confounded; and intellectual acumen is exhibited, not in synthesis or the appreciation of the resemblances, but in analysis or perception of the differences: especially is this the case, when the like forms are contrasted with others; the differences are then still more lost sight of and overshadowed by the closer common bond coming into bolder relief in contrast with the unlike. For example, it requires no penetrating acumen to recognize man, the monkeys, the bats, the typical ruminants and the typical cetaceans as distinct forms existent in nature. But such are fair examples of the groups for the appreciation of which Aristotle has been so highly lauded,—groups which from their very nature in their integrity first appeal to the senses, and which only minute analysis enables the observer subsequently to differentiate into ultimate constituents.

4. Subordination of groups. — If, too, modifications of the

*In another place, he recognized the homologous relations of the members in man and the monkeys, remarking that both the arms and legs are flexed as in man, and curved towards each other. (II, v, 3.)

† Yet Aristotle does not seem to have recognized this relation, as he remarks that the lion's internal parts, when exposed, resemble those of a dog.

members are to be considered, it would be rather a person of peculiar idiosyncrasy whose attention would not be first arrested by the characters exhibited by man (biped), quadrupeds, and whales (fish-like and without hind limbs).

Equally probable would it be that, when examining the feet of quadrupeds, his attention would be first arrested by the differences seen in the hoofed and unguiculate mammals; and if, further, the former were studied, the cloven hoof of the ruminant, the solid one of the horse, and the divided one of the elephant would be equally likely to first attract attention. And yet these obvious points of structure are almost the only ones noticed by Aristotle. He made no attempt to coördinate them, to subordinate the groups so distinguished, or to assess a taxonomic valuation on characters or groups; in brief, there is no evidence of definite ideas of classification having occurred to him. It may, indeed, be well believed that some indistinct perception of system must have flashed upon the mind of such a man, but the impression was too undecided and intangible to be seized and embodied in a system.

Those groups which Aristotle recognized are the crude materials with which the naturalist has to deal. He was unacquainted even with the characters which furnish the criteria for classifying them, and to assign to him any definite views respecting their relationship is an anachronism and may involve a wrong to himself.

In fine, there is, so far as I can perceive, not the slightest evidence of any recognition of what is now understood by classification in any of the extant treatises of Aristotle on animals, and the systems framed to embody his generalizations have been constructed from isolated sentences wrested from their context and simply reflect the framer's notions or his ideas as to what Aristotle might have supposed.

And, as a hearty admirer of the great philosopher (more excellent in intellectual than in physical science), I may claim a right to protest against systems (like that, *e. g.*, published by Macleay) which have been fathered upon him; I may assume that had his attention ever been challenged, he might have better appreciated the relations existing between the groups which he, in common with daily observers, perceived.

Careful and repeated perusal of Aristotle's biological treatises have, in fact, failed to convey to the writer any impression save

that he was a tolerably good observer and compiler, and surpassed ordinary men, perhaps, in ability to embody in words the results of his observations of various disconnected facts. There is, however, no coördination of the facts observed, no valuation, and no subordination which would entitle his observations to be considered as a body of scientific facts or doctrine. The materials for science exist indeed, but in a very crude and imperfect condition. Commendation of his work as a model of scientific treatment betrays a phase of mind and appreciation which is not readily comprehensible, and has only found expression in vague eulogy without proffer of the proof or basis for the encomiums. It need only be added that in this opinion I essentially agree with some of the best qualified students of the works of the great Stagyrite. Of these, I need only mention especially the several treatises of Dr. Whewell,* the great master of Trinity college; Prof. Carl Sundevall† who has published a commentary on several of the classes treated of by Aristotle; and Mr. George Henry Lewes‡, who has devoted a special work to an examination of Aristotle's various treatises. The verdicts of these gentlemen are pertinent and amply justified, I think, by the facts. The same can scarcely be said of the censorious criticism of the Grammarian of the Deipnosophistæ,§ or of the illustrious advocate of the inductive method‖, but even their judgments, or at least that of the last, are the natural result of antagonism to the opposite extreme.

At a future time, I may perhaps publish an analysis of the four capital propositions ascribed by Cuvier to Aristotle.

*Whewell (William). History of the inductive Sciences, from the earliest to the present time. . . . . [Various editions, book xvi, chap. 6.]

—— —— [On the Philosophy of discovery, chapters historical and critical . . . . London: John W. Parker and Son. . . . . 1860. (pp. 23-78.)]

†Sundevall (Carl Johan) Ett försök att bestämma de af Aristoteles omtalade Djurarterna. . . . Första afdelningen: luftandande djur, eller Klasserna: Däggdjur, Foglar, Reptilier och Inseckter med Arachnider . . . . Stockholm . . . . 1862 . . . . [4to, 148 pp.] < Kongliga svenska Vetenskaps-Akademiens Handlingar. Ny följd. iv, 1864.

—— —— Die Thierarten des Aristoteles von den Klassen der Säugethiere, Vögel, Reptilien und Insekten . . . . Übersetzung aus dem Schwedischen.—Stockholm, 1863, bei Samson Wallin. [8vo, 242 pp.] A translation, edited by the author, of the preceding.

‡Lewes (George Henry). Aristotle: a chapter from the history of science, including analyses of Aristotle's scientific writings. . . . . London: Smith, Elder and Co., ... 1864.] 8vo, x, [1] 404 pp.] (see, especially, pp. 269-279.)

§Athenæus. Deipnosophistæ, Book viii, c. 47-50.

‖Bacon (Francis *Lord*). Novum Organon, [various editions, Pars I, Aph. lxiii,] etc.

SENSITIVE STAMENS IN PORTULACA.

BY PROFESSOR C. E. BESSEY.

Two years ago my attention was first called to the sensitiveness of the stamens of *Portulaca grandiflora*, by observing a peculiar motion in them, while a small wild bee was engaged in gathering honey, and perhaps pollen, from the flowers. Upon trial I found that I could, by touching the stamens, make them move through quite considerable arcs of circles. I pursued the investigation somewhat farther at the time, but on account of a pressure of work was compelled to drop it. Last year I again made some examinations which confirmed my previous observations, but declined calling special attention to the facts until I had had opportunity for examining Claytonia as well. This last I have been enabled to do this spring, and having now again verified my observations on the Portulacas can give the results.

In both the common species of *Portulaca* i.e., *grandiflora* and *oleracea*, if the stamens are brushed lightly in any direction, they will immediately with a strong impulse bend over toward the point from which they were brushed; for example, if a pin be made to pass through the stamens from left to right, they will bend from right to left; if the direction of the pin be now reversed so as to pass from right to left the stamens will spring back from left to right, and this reversal of motion may be continued for some time, of course with diminished energy. The motion seems to be induced by a *pushing* or *bending* of the stamen, as simply touching it appears not to affect it at all, and the direction of this motion seems to be determined by, and always *contrary* to, the pushing and bending. The object of this is, I think, evident. When a small insect visits the flower and struggles through the thicket of stamens, as it bends them away from itself, they will react and bend closely against the sides of the insect's body, covering it with pollen, which will be thus carried from flower to flower. Thus far I have not noticed any special arrangements for providing that the pollen of any flower shall not fertilize its own ovules; nor have I found any contrivances for certainly making the pollen deposited on the body of an insect come in con-

tact with the stigmas of the next flower visited. The stigmas are however raised considerably above the tops of the stamens, which *may* sufficiently guard against self-fertilization, and as they diverge quite widely it is *possible* that they are touched by insects before the stamens are.

Hoping to get more light on this point I examined with much care a large number of flowers of *Claytonia Virginica* with the following results:

The stamens of Claytonia (this species, at any rate) are not sensitive,—or at least not appreciably so. They however have a motion which appears to accomplish the same probable result, namely, the securing of cross-fertilization. When the flower first opens, its five stamens rise parallel with the three cleft style, and at this time the anthers may or may not be shedding their pollen, but *the stigmas are closed*, the three stigmatic surfaces being closely applied to each other so that the style appears as if entire and single. After an undetermined time the lobes of the style begin to diverge, and the stamens then, or a little before, recede, so that when the stigmas are fully exposed the anthers are turned back as far as the opposite petals will allow them to be. In the majority of cases the stamens seem to bear with considerable force upon the petals, the anthers touching nearly the middle point of the petals, while the filaments are arched as in *Kalmia glauca*.

From my observations I am led to think that after fertilization has taken place the stamens regain to a greater or less extent their first position—though of this I cannot speak with certainty. The arrangement here seems to be beyond a doubt for preventing self-fertilization, and I have no doubt that had time permitted, some contrivance for securing the interchange of pollen would have been found. This must however be left for the next spring's examinations.

STRIÆ ON MOUNT MONADNOCK.

BY G. A. WHEELOCK.

Having in the last three years spent many days in studying the striæ on Mt. Monadnock, the writer is unwilling that the results of his observations should be lost for want of record, especially as they seem to have an important bearing upon unsettled questions of surface geology. This mountain is peculiarly favorable to such study. Its long spurs radiating from a central elevation, although less regular than the points of a star, yet present to four points of the compass long ranges of bare rock, which have recorded the markings of the ice period with all their variations of direction, and furnish a lesson not to be found, perhaps, in any other locality.

To understand fully the meaning of the evidence herein detailed, it is necessary to have a clear idea of the relative bearing and position of these radiating ridges or spurs.

For the sake of clearness of description we will suppose the principal ridge, which runs north 25° east, to be straight, and to be four miles long. This ridge was an uplift, sloping toward the west, and presenting its broken and precipitous face toward the east. It is like a dam set obliquely across the current of the northern drift, and its serrated edge rises from fifteen hundred to two thousand feet above the surrounding country, growing higher from each end toward its central parts. If we suppose a section of this range near the centre to be pushed some fifty rods farther west, and elevated to the height of three thousand two hundred and eighty feet, we shall have the summit of Monadnock. A short spur projects west of the summit about a mile, and divides into two branches; these we will call the west and northwest spurs. The two ends of the dam we will call the north and south spurs; these with the western spur and its northwest fork complete the outline of the mountain, making four radii.

Numerous observations of the direction of drift striæ made in the adjoining towns show very general uniformity. They have a range of not more than 15°, varying 15° west of north to north and south. On the summit of Monadnock the direction varies within the same limits. Only one set of striæ were noted there

as 5° east of north. So too, following along the northeast spur, there is no change in the striæ so long as the altitude remains the same. The crest is all naked rock for two miles and a half, or three miles, and frequent observations can be made. Just as fast as the ridge falls off in height the striæ gain a more westerly direction, becoming 15°, 20°, 25° west of north; where the rocky ridge terminates and is succeeded by open pastures, 30°, and in many places 40° west, were noted as common. Appearances indicated a local deflection of a current around the northern end of this long dam.

Although a special expedition was made to what I have called the northwest spur, the lower portion of it was so much covered with drift that few exposed places could be found; some five or six however, and all that were noted, showed striæ north 25° east. All the higher portions of the ridge were striated like the summit and the ridge before described.

Another day's expedition was made to the west spur. Standing on the crest of this lofty ridge and looking toward the south, the view is unobstructed to the horizon. The striæ all along this ridge are innumerable and all north and south. There is no opposing ridge near, to lead one to expect south of this a change in the striæ. On the contrary there is every facility for the drift current after passing this ridge to continue on in a straight course. The southern spur is a mile or more off on our left and presents a high opposing barrier toward the southeast but none toward the south. Why should the drift current after passing this ridge, suddenly turn toward the east and climb the steep and lofty barrier of the south spur? Nevertheless there are indications of just such a change as this.

If we place one foot of a pair of imaginary compasses on the summit of Mt. Monadnock, and with the other strike a curve from the west spur to the south spur, we shall hardly have made a more complete change of direction from one spur to the other, than is indicated by the striæ in the short space of a mile and a half. It is difficult to pass over all parts of the valley between these two spurs, the upper portion of it being extremely craggy or uneven. It is better to go down to the open pastures at the base of the mountain. Beginning at the foot of the western spur and skirting the base of the mountain toward the east, the first thing to excite attention is the immense number of bowlders. They exceed in

multitude any other deposit about the mountain, but form no part of its talus, which does not fall on this side. They seem to be in some way connected with the change of the drift current, which began at this place, and with the position of the ridge under the lee of which they lie. Passing through these bowlders which continue for half a mile or more, we come to the first bare ledges; these are marked with striæ, N. 20° W. These are soon succeeded by others thirty, forty and fifty degrees west of north. They may not occur all in regular order; on some ledges there are two or three sets of striæ of different angles. Proceeding a mile and a half we arrive at the easterly slope of the south spur near the Mountain House. The road to this house was built north and south on sloping ground, and for half a mile the fresh surface of the rock was in many places exposed to view. It is everywhere scratched and polished. These scratches vary from 50° to 60° and 70° west of north. Climbing the slope of the ridge, everywhere the exposed prominences of rock are embossed in the same direction. Arriving at the crest of the ridge, it is everywhere serrated and uneven.

On this height we again overlook the whole country. Here on the narrow crest of the ridge the striæ are very generally north 40° or 45° west. In one place an angular trough perhaps twenty feet long and six feet deep runs across the crest. In this there are long continuous striæ due east and west. They appear to be exceptional and suggest the idea that this shallow trough had been able to control and change the direction of the striating force. Standing on this ridge and looking toward the east, we see that the mountain on this side is very precipitous, and that probably there are no striæ on its broken surface. Higher up the mountain, within a thousand feet of the summit, the striæ are 35° and 30° west of north; lower down at the extremity of the south spur, the end of the long dam, they vary from 40° to 25° west of north. What kind of striæ should we expect to find under the lee of this four mile breakwater? Another expedition and another day were required to answer this question. The country east of the four mile ridge is mostly wooded and difficult to traverse. The rock is mostly covered with drift. Beginning at the south end and travelling north, no striæ were found until two-thirds of the distance had been passed over. Curiosity was at last gratified by finding large flat surfaces of naked rock scored all over with long parallel

lines much better preserved than those on less wooded and more exposed parts of the mountain. It would be difficult to decide what was their prevailing direction. Multitudes ran due east and west; some few north and south; some north 10° west; some north 10° east; many north 70° and 80° west; many north 70° and 80° east. No theory of mountain slides could explain this remarkable scratching; the situation seemed to forbid such an explanation. These observations were made on many different ledges, but all of them within a half mile of each other, and within a mile of the north end of the ridge. When a rapid stream with a current of three miles an hour passes a rock in its bed, water will flow around the rock and meet on its lower side. Do not these irregular striæ indicate a changeable and eddying current inconsistent with the motion of a glacier?

Mt. Monadnock furnishes some suggestions also on the subject of erosion. Chemical agency and the action of frost may properly enough account for a large amount of rock disintegration. On long lines of coast the ceaseless waves of the ocean cause an endless amount of erosion. But the amount of actual planing and grinding of the earth's surface by icebergs or continental glaciers seems somewhat speculative and furnishes small means of measurement. Whoever has had experience in grinding and polishing mineral specimens knows full well that, so long as there are protuberances or cavities on the surface he is grinding, he has accurate means of judging his rate of progress. But when he is grinding a flat surface, he has no means of judging from the surface itself. So here on a large scale, all along these naked mountain ridges there are rounded angles and mammillary protuberances of all dimensions, which are marked with striæ, but have never been ground down to a flat surface. They are rounded, scratched and often polished. Is it not possible to reconstruct the angles and edges that are worn off and thus have an approximate measure of ice erosion? On a hill in Keene there are acres of hard quartz rock lying uncovered and much exposed to glacial action. The rock is composed of laminæ an inch thick, and these incline toward the south. When the rock is fractured obliquely, the fracture is interrupted by each lamina, so that the edges of the laminæ project slightly like the serratures of a file. Now all over these sharp serratures there has been much grinding and polishing, but the shallow cavities originally between them have rarely

ly been ground out, and there is no reason for supposing that this hard rock has ever been eroded more than half an inch. On Monadnock, where the rocks have a regular jointed structure and the upper edge alone has been worn off, it is often easy to supply the lost angle, by reproducing the contiguous sides. Studied in this method an erosion of one or two feet would be as much as is indicated on all the higher portions of the mountain. On lower ground surfaces are more flat and judgment is at fault. Between the northwest and northeast spurs a wide valley opens out toward the drift current. This extended valley is filled with mammillated rocky protuberances projecting among the spruces which grow everywhere between them, from six to ten feet high. This valley is in the line of the drift and would be eroded if any place would, but the protuberant rocks seem merely to be rounded and the roughness of original fracture worn off.

A few words about the erratic bowlders in this vicinity may not be irrelevant. There are bowlders here of a phonolitic character, which often contain black porphyritic pebbles fused into their substance, making them very easy of identification. These have been a subject of special study, and some fifty of them have been found in Cheshire county. Prof. Charles H. Hitchcock, who is intimately acquainted with New England rocks, says he has never seen such rocks, in place, anywhere, except in the vicinity of Ascutney, Vt. Ascutney mountain was thrown up in a state of fusion, and its heat melted this conglomerate which lay close by it. Ascutney is about fifty miles from Monadnock and north 10° west. Two of these bowlders lie at the base of the Monadnock. There is one in Keene that must weigh one hundred tons. Many were found near together or in the same line; but many more show a great lateral divergence. Keene is forty miles from Ascutney, and in that distance many bowlders have diverged eight miles, or one mile in five from the starting point. These bowlders have been dug out of the drift at various depths. While it is difficult to imagine a continental glacier making so many and such wide diverging lines, it is also difficult to understand how icebergs could have picked up these bowlders and polished their hard material on so short a journey.

REVIEWS AND BOOK NOTICES.

ENTOMOLOGY IN MISSOURI.*—Not only is this report of much interest to the farmers and gardeners of the State of Missouri, but naturalists will glean from its pages some facts new to science. We may congratulate the citizens of Missouri on the publication of an official report, which is of a high economical interest, and is an estimable contribution to science. And while thrifty habits are suggested, many a farmer's boy is acquiring an interest in insects and their ways, that will surely lead him to observe facts for himself in after life. His judgment will thus be trained, and he will be a better farmer and a more trustworthy citizen. Hence these reports have a distinctive educational and moral bearing on the citizens of the state in which they are published. We shall now attempt to give our readers some idea of the thoroughly good scientific work done by Mr. Riley in his primary attempt at enlisting the interest of agriculturists in observing and restraining injurious insects.

Fig. 115.

Pimpla, parasite of Codling Moth.

After some preliminary remarks on insects and economic entomology, with some views on classification to which we cannot give our assent,† several pages follow on the mode of collecting and preserving insects, with full illustrations.

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*Fifth Annual Report on the Noxious, Beneficial and other Insects of the State of Missouri, made to the State Board of Agriculture. By C. V. Riley, State Entomologist. Jefferson City, 1873. 8vo, pp. 160. With cuts.

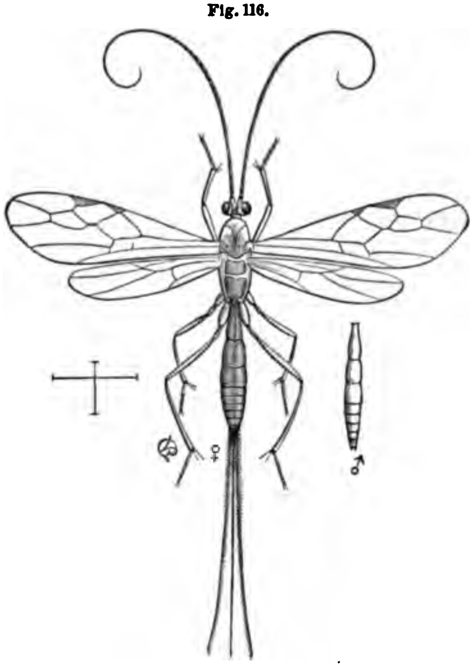
†For example, Rolleston was by no means the first to divide Articulata into Arthropoda and Vermes; it was done by Siebold in 1848, long before his work appeared.

As morphology indicates by the presence of four pairs of jointed appendages in the head, and embryology demonstrates by their early presence four rings in the head, our author's definition of an insect as 13-jointed does not express the whole truth.. He should say 17-jointed, or 14-jointed, counting the head as one, in a popular report of this sort. Four rings can be demonstrated in the head of an insect as easily as that the petals of a flower are modified leaves. Mr. Riley also takes a back step in classification in separating the Strepsiptera from the Coleoptera, the fleas from the Diptera, and the Thysanoptera from the Hemiptera. It is strange if over thirty years of observa-

Two ichneumon parasites (Fig. 115, *Pimpla annulipes* Br. and Fig. 116, *Macrocentrus delicatus* Cress.) have been discovered attacking the codling moth, while ants, cockroaches, and the larvæ of certain predaceous beetles (*Trogosita nana*, etc.), play no unimportant part in destroying the well known apple worms.

We have farther information concerning the grape Phylloxera. Mr. Riley offers the opinion that the mortality among the grape vines in this country for two or three years past may be due to this insect, and from the statements he makes we should judge that he is correct, and if so every vine grower must make himself as familiar with the habits of this insect as he now is with the manure he uses upon the vines, or the mode of training and pruning them.

Fig. 116.



Macrocentrus, parasite of Codling moth.

The Phylloxera is found as far west as Manhattan, Kansas, and as far south as Florida. In Europe it is spreading in Portugal and Switzerland, and in some parts of Germany, while in England it is doing serious injury to hot-house grapes. In France so threatening has it become that the French Academy of Science has a standing Phylloxera committee, and M. d'Armand, at one of its sittings, demanded that the premium of 20,000 francs, offered

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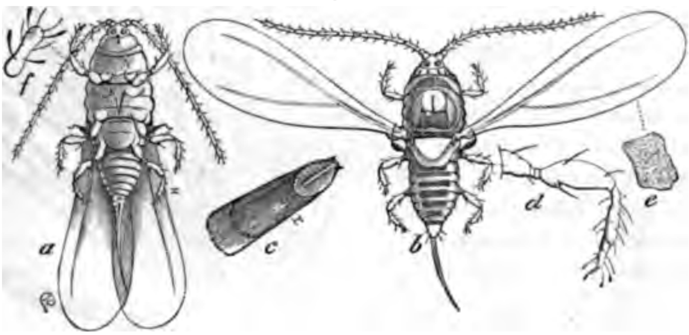
tion should not enable us to advance beyond Westwood's classification, admirable in 1840, but in many respects obsolete in 1873.

Again, our author states that embryological data "though of great value as pointing to the derivation of insects—their homologies and relations to the past—do not always subserve the best interests of classification." We would inquire what is classification but an attempt at tracing the genealogy of animals or plants?

by the government for a remedy, be increased to 500,000, or if necessary to 1,000,000 francs.

The accompanying figure (117) represents the male of the apple bark louse, which Riley calls *Mytilaspis pomicorticis*, regarding it

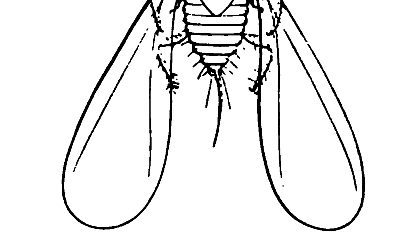
Fig. 117.



Male of Apple bark Louse.

as distinct from the *A. pomorum* Bouché of Europe, from the fact that the eggs of the European species are reddish-brown, while those of our species are white. Care should here be taken in ascertaining how soon after being laid the eggs are observed, as they may vary in color with the age of the embryo within. Certainly we have been unable to detect any difference between the bark louse of the apple as we have observed it in Jena, Germany, and our species, having compared numerous specimens of both. Undoubtedly our species has been imported from Europe, and it would have been the better way,

Fig. 118.

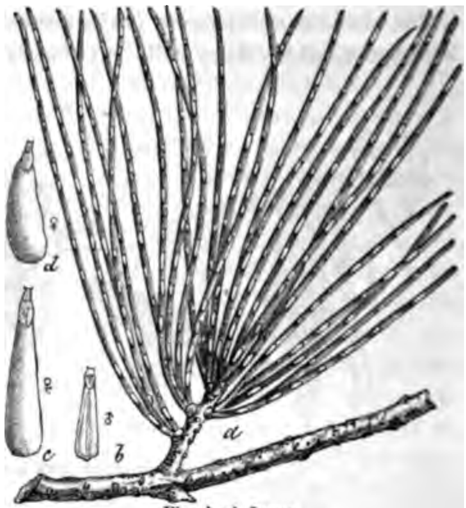


Male of Pine bark Louse.

we think, to regard our species as identical with the *M. pomorum* (Bouché) than to give it a new name. The leaves of the white and other pines are sometimes so much affected by a long narrow bark louse, *Mytilaspis pinifoliæ* (Fitch), (Fig. 118 male, Fig. 119 *b*, the male scale, *c*, female sca˙ w leaved; *d*, variety on

broad leaved forms of Pinus) as to kill the tree. The male (Fig. 118) differs from the male of the apple bark louse in being of a uniform orange-red. The species is double brooded, while the apple bark louse has but a single brood in a season. Drs. Fitch and LeBaron, as well as Mr. Riley, seem only to have found it on cultivated pines, but we have found it frequently in June of the present year on the leaves of the white pine at Brunswick, Maine.

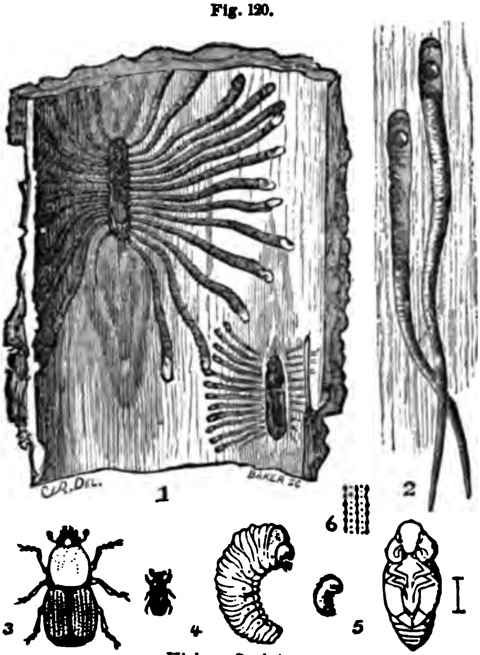
Fig. 119.



Pine bark Louse.

We then have an account of the habits and transformations of *Scolytus caryæ* Riley, the hickory bark borer (Fig. 120, 1, burrows of young larvæ, which afterwards run lengthwise along the bark 2; 3, beetle enlarged and of natural size; 4, larva; 5, pupa.) It infests the hickory, pecan and other species of Carya.

Fig. 120.



Hickory Scolytus.

The chapter on stinging caterpillars is in the main corroborative of Mr. Lintner's interesting remarks on this subject. One of the most prominent of these larvæ is that of *Hemileuca Maia* (Fig. 121 male, Fig. 122, eggs, Fig. 123, larva,

b, pupa, *c–g*, different spines). Another is the Io moth (Fig. 124 male, Fig. 125 female, Fig. 126 larva, Fig. 127 spines).

Appended to the report is an article "On a New Genus in the Lepidopterous family Tineidæ: with remarks on the Fertilization

Fig. 121.

Hemileuca Maia.

Fig. 122.

Eggs of Maia Moth.

of Yucca." This insect is called *Pronuba yuccasella*, and its appearance and structure may be learned from an examination of the annexed drawings (Fig. 128, *a*, larva, *b*, *c*, moth, *d–k*, head and details of larva; Fig. 129 shows the strange form of the head; *b*, maxillæ and their palpi, *e*, a scale, *f*, a leg, *g*, labial palpus, *h*, fore, *i*, hind wing; Fig. 130, pupa of male and female). Dr. Engelman had drawn attention to the fact that the yucca is incapable of self-fertilization, and Mr. Riley acquaints us with the yucca moth which effects it. He observed that at night "with her maxillary tentacle (Fig. 116), so wonderfully modified for the purpose, she collects the pollen in large pellets, and holds it under the neck and against the front trochanters. In this manner she sometimes carries a mass thrice

Fig. 123.

Larva of Maia Moth.

the size of her head (Fig. 129 *a*1). Thus laden, she clings to the top of the pistil, bends her head, thrusts her tongue into the stigmatic nectary, and brings the pollen-mass right over its mouth. In this position she works with a vigor that would indicate combined

Fig. 124.

Hyperchiria Io male.

pleasure and purpose—moving her head and body from side to side, and apparently making every effort to force the pollen into the tube. Such is the method by which our yuccas are fertilized."

Fig. 125.

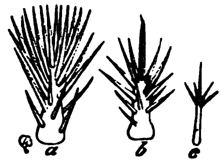
Hyperchiria Io female.

Riley thinks that the eggs are thrust into the fruit "from the side or from the stigmatic opening, following, most probably, the course of the pollen tubes." In a day or two after the flowers have withered the young fruit contains generally two young larvæ.

Fig. 126.

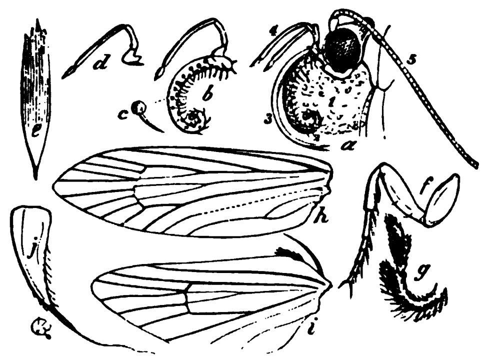
Larva of Io Moth.

Fig. 127.



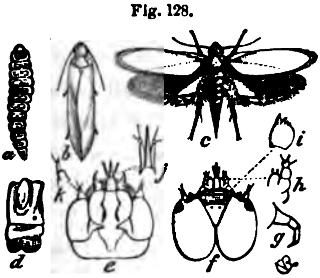
Spines of Io Moth.

Fig. 129.



Yucca Moth, details.

Fig. 128.



Yucca Moth, larva, etc.

Fig. 130.

Pupa of Yucca Moth.

NOXIOUS, BENEFICIAL AND INJURIOUS INSECTS OF MISSOURI.

THE TINEIDS OF NORTH AMERICA.* — Our gratitude is due to Mr. Stainton for this kindly act of international courtesy in preserving in a permanent form the part of Dr. Clemens' scientific writings (and they were all confined to the Lepidoptera) relating to the family of Tineidæ. Dr. Clemens was fortunate in the beginning of his studies, in the friendship of so able a naturalist and kind a helper as the editor. For our part, who owe so many favors to Dr. Clemens, and also have derived so much aid and stimulus from Mr. Stainton's works, we appreciate fully this mark of friendship.

Little new matter, but a number of new woodcuts appear, from Dr. Clemens' pencil, being mostly outlines of the venation of the wings of these small moths. Nine letters to Mr. Stainton, and a few pages of other matter, are added to what has already been published in the Proceedings of the Academy of Natural Sciences, and the Entomological Society of Philadelphia.

BOTANY.

ON CROSS-FERTILIZATION AS AIDED BY SENSITIVE MOTION IN MUSK AND ACHIMENES.— The sensitive motion of *Mimulus* has been well known, at any rate, since the time of Sprengel, who curiously enough includes this proper motion among those to account for which he says "we are obliged to suppose an internal impulse, a force independent of external influences.† In this category he places the stigmatic movements of *Mimulus*, *Martynia*, and *Scævola*, and the movements of the stamens in *Parnassia* and other plants. The object of the movements of the stamens in *Parnassia* was already connected in his mind with that of insect agency, and this has since been conclusively established by other botanists.‡

I am not aware that a like connection has been noticed between the stigmatic movements of musk, and the necessity of insect fertilization. Vaucher remarks that during *the time of fecundation* *M. luteus* and *M. glutinosus* will, as he himself has tried, close at

* The Tineina of North America, by the late Dr. Brackenridge Clemens. (Being a collected edition of his writings on that group of insects.) With notes by the editor, H. T. Stainton, F. R. S., London, 1872. John Van Voorst, 8vo. pp. 282, with woodcuts.

† Sprengel's "Anleitung zur Kenntniss der Gewächse," part i, p. 274.

‡ See A. W. Bennett's paper in Journ. Linn. Soc., vol. xi, p. 26.

the slightest touch. The sensitiveness will be seen to play a useful part in this fecundation.

I will take the commonest species, *M. moschatus*, as a type. The flowers vary from erect in the bud to horizontal in the full blown flower, but never hang downwards. Of the four stamens the anterior, lower, and larger pair ripen after the posterior, upper, and shorter pair. Both pairs of anthers are held together by hairs, and the longitudinal slits of the anther open towards the lower lip, and away from the base of the flower. The style is closely pressed against the upper lip of the corolla, and its stigma has two large flat fan-shaped lobes. In a very young bud these lobes are closed. In a hardly opened bud the lobes are beginning to open, the lower one bending back against the style; at this time it is that the shorter stamens burst, but as they are much shorter than the style the pollen cannot reach the stigma, and its course down the tube is facilitated by the, at that time, slanting position of the flower. In a just opened flower the stigmas are fully open, parallel, and opposite to the lower lip of the corolla, its viscous surfaces being therefore both downwards; the shorter anthers are nearly empty, and the longer only just beginning to split; the pistil is therefore synacmic with the shorter, and almost protogynous with respect to the longer stamens.

In a flower almost beginning to fade the longer stamens are still shedding their pollen, the shorter ones are withered, and the stigma be-pollened and in many cases closed. This closing may, moreover, be experimentally produced by touching the stigmatic surface with a pencil, in which case the stigmas will close in about thirty seconds. In faded flowers, whether from contact or otherwise, the stigmatic surfaces have closed.

From these facts it will appear that self-fertilization by the shorter stamens is impossible, and that it is rendered improbable by the longer stamens (1) by their bursting late; (2) by the direction in which the anthers open; (3) by their not reaching as far as the stigmas, and, as being anterior, by being some slight distance from the upper lip; (4) from the probability that the stigmatic surfaces may have been touched and closed before they burst at all.

On the other hand, an insect attracted to the flower for the honey could hardly leave the flowers without some pollen on the upper side of his body or on his proboscis. The hairs which hold

the anthers together no doubt facilitate this, as they do in *Pedicularis*, by keeping the stamens from separating. The large size of the stigmatic surface will of course increase the chance that any insect with pollen on its proboscis or back will not fail to leave some grains attached to it as he works his way towards the bottom of the flower.

But what purpose does the sensitiveness serve? To prevent the stigma being fertilized by its own pollen by insect agency. Without this sensitiveness why should not an insect covered with the pollen of the shorter and synacmic stamens leave the pollen on the stigma of the same plant as he backs his way out? Given the sensitiveness, this is impossible, for as the insect passes under the stigma the sensitive motion is excited, and while he is drinking the honey time is allowed for its completion, or if it be not completed in time, the mechanical effect of the backing motion of the insect will be to complete the closing.

A similar use of a quite different movement has been suggested to me by Miss S. S. Dowson, one of my Cambridge corresponding class. The *Achimenes* (Gesneraceæ) has a tubular corolla five-cleft with a swelling just below the top of the throat. There are four perfect stamens, not much differing in length, and the stigma is ultimately two-cleft. In the bud the pistil is much shorter than the stamens, but by the time the bud is just opened it has lengthened out between the stamens, and its tip is adpressed to the upper lip of the corolla. As yet the stigma has its two branches closely folded together. The anthers at this time are all four close beneath the end of the pistil, and open downwards. The filaments then begin to contract, and the anthers, which adhere together, are drawn lower; and finally the filaments twist themselves up to such a degree that the anthers are drawn down to the very base of the tube. The object of this is clearly to get them out of the way of the stigma, for during the process the pistil has arched forwards and downwards, and the two branches of the stigma have opened. They will be seen to form a fork over a slight rising in the middle lip of the corolla, by which entrance to the flower, except exactly under the stigmatic surfaces, is prevented.—F. E. KITCHENER *in Trimen's Journal of Botany.*

NARDOSMIA PALMATA.—Looking over the NATURALIST for April, 1872, I find this plant mentioned by Prof. Tenney, as occurring in

Amherst, Mass. with the query "What are the New England localities of this rare plant?" During 1859-60 I found it in the vicinity of Bangor, Me., on land newly cleared and burnt over, growing as abundantly as erechthites or any of the "fire weeds," many acres being entirely covered with it.

Making a trip subsequently to Mt. Katahdin, nearly one hundred miles north from Bangor, I found it abundantly, at intervals, in clearings, all along the route. But I have never found it elsewhere in New England.—J. W. CHICKERING.

[It is known to occur in Brunswick, Maine.—EDITORS.]

THE USES AND ORIGIN OF THE ARRANGEMENTS OF LEAVES IN PLANTS.—A paper by Chauncey Wright, with the above caption, appears in the last part (vol. ix, part ii) of the Memoirs of the American Academy of Arts and Sciences. It is a philosophical and exceedingly interesting discussion of the subject, and we shall endeavor to bring it to the notice of our readers in a subsequent number.

ZOOLOGY.

SPONTANEOUS DIVISION IN STARFISHES.—Mr. C. Lütken, of Copenhagen, so well known for his important researches on the natural history of certain groups of the Echinoderms, has recently laid before the Royal Academy of Copenhagen the results of some very interesting and valuable investigations on the spontaneous division of the starfishes and brittle-stars. Professor Verrill has recently described a new genus of brittle-star (*Ophiothela*), all the known species of which possess a number of arms greater or less than five, generally six, and in some few instances three or two; very rarely indeed does the normal number of five make its appearance. Lütken describes a new species of this genus (*O. isidicola*) on a certain number of specimens of which he finds six nearly equal arms, but in the majority of these specimens there is a marked difference between the three arms on one side of the body and the three arms on the other; in another set the difference is still more marked, the one set of three arms being quite small and the other of the ordinary size. In others, again, this difference is extended to the disk itself, and it looks as if it had been cut in two by a knife. In all these cases there can be little doubt that these appearances result from a primary division and then a regeneration

of the parts that had been divided off. It becomes an interesting question how often such division could take place in any individual; without being able to pronounce any positive opinion on this point, Lütken inclines to the belief that up to a certain age it can be repeated several times. Allowing that the faculty of regeneration is very great among the ophiuroids (a disk of an ophiura deprived of all its arms will sometimes under favorable circumstances renew them all), still the phenomenon witnessed in *Ophiothela* differs from a mere casual renewal of lost parts of an accidental lesion; there is a regularity and symmetry about it which certainly points to a true natural spontaneous division having for its object the multiplication of the individual. It must not be forgotten, moreover, that Profs. Steenstrup and Sars have observed the same phenomena in certain small ophiuroids with six arms, especially among species of the genus *Ophiactis* that live intertwined among corals and sponges, nor that the truth of their observations has been confirmed by Lütken himself. In one or two species of another genus, *Ophiocoma* (*O. pumila*), the same thing occurs; in these instances it becomes clearly apparent that in young individuals only this agamic form of reproduction takes place, and that with the adult forms the results of the division are truly sexual. Similar phenomena have been remarked in certain *Asteridæ*, notably in *Asterias problema* Stps., and in some allied species described by Verrill, as well as in *Linckia ornithopus* and *Ophidiaster cribrarius*. Lütken is of opinion that though there are many cases where the spontaneous division is merely gemmation more or less disguised, there are likewise many instances in which it is, so to speak, simple division and nothing else. In the case of the ophiuroids and asteroids he inclines to think it a normal form of multiplication, which takes the place of gemmation. It would have a near relationship to the power of regeneration on the one hand, and to that of gemmation on the other; and while it may not always be possible to clearly define the exact limits of these "powers," it is convenient to preserve to "Schizogony" an independent place among the different forms of agamic multiplication. The classifying of the phenomena above alluded to as occurring in the ophiuroids and asteroids in the category of "Schizogony," conclusively indicates, in short, that there is in this spontaneous division something altogether different from gemmation. The following general propositions are laid down by

Lütken:—1. The most energetic manifestation of the faculty of regeneration in animals is the power of divisibility; 2. In certain forms of Radiates, in which the faculty of regeneration is very highly developed, spontaneous division takes place only, as in ophiuroids and asteroids, or together with gemmation as in Actinia; 3. Actual spontaneous division or schizogony in the Actinia, Medusa, asteroids and ophiuroids, which must not be confounded with the disguised form of gemmation met with in Infusoria and certain heteropods, may be regarded as a peculiar form of agamic reproduction, such as Blastogony, Sporogony and Parthenogony. —*Nature.*

HABITS OF A SPECIES OF SOREX.— As far as my observation goes this is the most diminutive animal among the quadruped type. It is the musk — I had like to have said mouse — but except the incisors, it resembles the Talpa family more than it does the Mus. They are rather rare. Indeed until the present year I had never seen one of them. They dwell in warm nests, made of grass, under rocks, old logs, or old castaway rails, about the fences or edges of the prairie. They do not come about the houses, and are purely nocturnal. I have found only three nests of them. They have four young at a time, which they nurse and care for most affectionately. I had a family of them and fed them a week, where I could observe all their actions. I had the father and mother and their four half-grown offspring. They were pretty pets, and I had hoped to succeed in sending the whole family to you, but our cherished hopes are often frustrated. The male made his escape, and finding another newly married pair — they do marry, and as far as I can learn, stick together as long as they both live — I put them into the box with my half civilized family. The male instantly caught a young one and was aiming to kill it, when I put him and his companion into an empty oyster can, and setting it back in the box, went to supper. When I returned, I found that the ferocious rascally male had made shift to get out of the can, and had murdered all the young ones. I was very sorry for the loss, and thinking he had done all the mischief he could, turned his wife out of the oyster can, and left them in the box with the bereaved and deeply afflicted mother. Next morning I found they had murdered the sorrowing mother and had eaten her very nearly up. These last two captured cannibals I have sent you. The

young are born blind, and remain so until they are half grown certainly, perhaps longer. The male seems to care for and assist in rearing the young. He will go out and capture a grasshopper or cricket, carry it home and give it to his nursing companion. All the actions, one to the other, of a married couple, indicate in the untrammelled state, much affection and caressing attention. No bear or panther could manifest a greater degree of ferocious destructiveness than does the male of this diminutive tribe of animals when he is molested by his kind, or when he comes in contact with a rival. The odor emanating from the box in which I kept them, when the box is clean, is dilute musk, with a slightly sweet accompaniment. They have their young about the 10th of February, that is, as far as my observation goes. How long their period of gestation, or how often they produce their young, is not yet known to me. They sleep all day. I have had opportunity to make observation on the action of four half and four full-grown specimens, some of them through a period of twenty days. The results are recorded above. I wish you to examine them and give me their name and tell me to what families they are allied. —*Abstract of a letter to the Smithsonian Institution by* G. Lincecum, *Long Point, Texas.*

Aleutian Cephalopods.—In the winter of 1871–2 at Ilinlink, Unalashka, a large number of giant cuttles were stranded at various times. One of these, a species, apparently, of *Pinnoctopus*, measured six feet from tip to tip of the arms, which were much mutilated, or about fifty-two inches from the posterior extremity of the body to the ends of the arms as they remained. The color was white, ocellated with brick-red and the larger suckers measured twenty-five inches across.

A still more remarkable form, however, was subsequently obtained, perhaps the *Onychoteuthis Bergi* Licht., one specimen of which measured from the posterior end of the body to the mutilated ends of the tentacular arms one hundred and ten inches with a body girth of nearly three feet, and weighing nearly two hundred pounds. Another specimen more mutilated measured eighty inches in length. The larger one could hardly have been less than ten feet long when perfect, the pen measuring sixty-one inches. The buccal mass containing the jaws was about the size of a small orange. The *Octopus punctatus* Gabb, which occurs at Sitka abun-

dantly, reaches a length of sixteen feet or a radial spread of nearly twenty-eight feet, but the whole mass is much smaller than that of the decapodous cephalopods of lesser length. In the Octopus above mentioned, the body would not exceed six inches in diameter and a foot in length, and the arms attain an extreme tenuity toward their tips.

There can be no doubt whatever that some cephalopods in the warmer seas attain an enormous bulk as well as length. Capt. E. E. Smith, an experienced sperm whaler, and a careful and intelligent observer, informs me that he has seen portions of "squid" arms vomited up by the whales in their death agony, as large as a "beef barrel," with suckers on them "as big as a dinner plate." I have no doubt of the correctness of this statement. Mr. Henry G. Hanks, of the San Francisco Microscopical Society, reports having seen, when on a voyage in a trading schooner among the South Sea Islands, a cuttlefish near the surface of the water, "as large as the schooner!" While this is rather indefinite still it indicates that specimens much larger than any yet recorded may probably exist in those regions. I have also rather vague reports of some enormous squid which have been observed in the Gulf of California.—W. H. Dall.

Criticism on an Observation of Professor Thomson on Certain Sponges, etc.—On looking over the "Depths of the Sea" by Prof. Wyville Thomson (Macmillan and Co., 1873), my attention was called to an observation which, when taken in connection with what had been said a few pages previously, seemed to me to do great injustice to our distinguished naturalist, Dr. Leidy. In the March number of the American Naturalist for 1870 there appeared "Remarks on some curious Sponges," by Prof. Leidy. In this article, after calling attention to the views of the nature of the sponge, Hyalonema, as offered by Gray, Valenciennes, Milne-Edwards, Brandt, Bowerbank, Schultze, and Ehrenberg, Dr. Leidy observes, "Prof. Schultze regards the sponge mass as situated at the bottom of the fascicle, and its flattened extremity with the large oscules at the base. This appears to me to be the general view, but it has occurred to me that the sponge mass in its natural position was uppermost and was moored by its glassy cable, or rope of sand, to the sea bottom; perhaps to marine algæ. This opinion is founded on the circumstance that in

sponges generally the large oscules from which flow the currents of effete water are uppermost. The ends of the threads of the fascicle, with their reversed hooklets, are also well adapted to adhere to objects." Prof. Leidy, then noticing that the "beautiful Euplectella of the Philippines was also at first represented upside down," concludes by giving a clear description of the Pheronema, a sponge "apparently intermediate in character with Hyalonema and Euplectella—(which would) "appear to throw some light upon the question of what belongs to Hyalonema."

The observation of Prof. Thomson, to which I have referred, will be found on page 426, and is as follows: "Perhaps the most singular circumstance connected with this discussion was that all this time we had been looking at the sponge upside down, and that it had never occurred to any one to reverse it." Reading this quotation by itself one would naturally suppose that Prof. Thomson had simply been ignorant of what Dr. Leidy had already published, but at page 418 of the same work, "the Depths of the Sea," in describing a sponge resembling Holtenia, Prof. Thomson remarks "I was inclined at first to place this species in the genus Pheronema, but Dr. Leidy's description and figure," etc. Evidently, then, Prof. Thomson was familiar with what Dr. Leidy had published in reference to these sponges. Why therefore does he unjustly ignore the fact that Dr. Leidy was the first to describe correctly the position of Hyalonema by saying "we had been looking at the sponge upside down and that it had never occurred to any one to reverse it." We trust that Prof. Thomson will now gracefully throw up the sponge.—Henry C. Chapman.

Embryology of the Lepidoptera.—The distinguished Russian embryologist, Prof. A. Kowaleusky, gives us in a late memoir (Embryological studies on Worms and Anthropods, St. Petersburg, 1871), the first definite information we possess as to the mode of development of the Lepidoptera. He finds that development goes on very uniformly in very remote genera. The primitive band is confined to one side of the egg and sinks a little way into the yolk; it is thus an endoblast, as Dr. Dohm had previously stated from the observations of Herold. The outer membrane, which surrounds the yolk, and is developed from the primitive blastoderm (the amnion of most authors), is called the "serous membrane," by Kowaleusky, while the inner membrane, which

arises from the primitive band, and apparently corresponds to the "faltenblatt" of Weismann and others, he calls the "amnion." Scarcely has the primitive band sunk down into the yolk, than it immediately greatly increases in size and length, until from being only twice as long as broad, and confined to one side of the egg, it surrounds the yolk. At this time the segments are indicated, and the rudiments of the appendages of the head and thorax appear. At a little later stage, the rudiments of ten pairs of abdominal feet appear, corresponding to the number of abdominal segments (in Sphinx). Ten abdominal segments may be set down then as the normal number in the Lepidoptera. The embryo with fully formed organs remains surrounded by the yolk, which it "gulps down its mouth parts, which meanwhile have been perfected." It then devours the "amnion," and finally the external "serous membrane." It has now obtained its characteristic colors and hairs, and lies curled up on its ventral side until it gnaws through the chorion and effects its escape from the egg-shell. From Kowaleusky's observations, we should judge that the Lepidoptera at first, though differing in some important respects from other insects, in others develop like Libellula, Telephorus and the Hemiptera and other endoblasts. In this respect, perhaps of not much importance, the development of the Lepidoptera is quite different from that of the Phryganeidæ. This, perhaps, indicates that there has been no genetic relation between the moths and caddis flies. Later, after the germ is formed, with indications of segments, the embryo resembles that of Diptera and Hymenoptera.—A. S. P.

The Purring of the Cat.—Since the vocalization of rodents has lately been a subject of study, it has occurred to me to inquire into that of one of their mortal enemies. Has any one expounded fully the mechanism of the purring of a cat?

The facts are these. The purr is a double or *to and fro* sound; it accompanies the breathing of the animal and is a respiratory phenomenon. It is in fact a vocalization, with the mouth closed. The vibration attending it is felt all over the chest and no farther, except in the throat.

On auscultation of a pussy during the purr, I found a very musical rumbling sound permeating the lungs throughout. Its character is changed, however, when the larynx is compressed; becoming higher as the voice does with narrowing of the glottis.

The vibration is also coarser to the ear in the throat than elsewhere. It reminds one there of the rattle connected with excessive secretion of mucus in the wind-pipe. But, as there is no liquid present, I ascribe the sound principally to a rough vibration of the epiglottis; supplemented no doubt, by an exaggerated vesicular murmur in the lungs, caused by a quivering, semi-convulsive mode of action of the respiratory muscles.

Perhaps all this may be familiar to most people, and I may have been before very unobservant in supposing the purring to be a general tremor of the whole body, having no connection with the breathing process.

Since writing the above note I have looked through a number of physiological works, without finding anything about "purring;" but at last, in the "Cyclopædia of Anatomy and Physiology," find the following remarks (Article Voice, Vol. iv, p. 1490):—

"The whole of the feline order [*sic*] are remarkable for the prominence of the superior ligaments of the larnyx, by which the purring is most probably produced. Vicq. d'Azyr ascribed the purring of the cat to two thin membranes situated beneath the inferior ligaments; but we [J. Bishop] were unable to detect them; nor could Cuvier, Wolff, Casserius and others, succeed in finding them."

This shows that the vocal nature of purring has been observed. I am sorry not to be able to refer to the memoir of Vicq. d' Azyr "On the Anatomy of the Vocal Organs in Mammals," 1779, to find whether he goes into detail in regard to it. Probably, in an anatomical treatise he does not.

THE "WILLOW WANDS" FROM BURRARD'S INLET.—Some peculiar specimens from British Columbia, resembling peeled willow switches were exhibited at the last meeting of the British Association, and were commented on in "Nature" and elsewhere by naturalists, among whom, Dr. P. L. Sclater (on the authority of some sea captain who stated that they were derived from a *fish*) suggested that if the statement were correct they might be the hardened notochord of some unknown fish. Several of the gentlemen referred to suggested that these organisms were the axes of alcyonoid polypes allied to *Pennatula* or *Virgularia*, and Mr. R. E. C. Stearns, in a paper lately read before the California Academy of Sciences, took the same view, suggesting that they might be allied to *Umbellularia*. That this view is the correct one, and

that the supposed fish was only a "fish story," there can be no doubt whatever. Very lately, Mr. Hemphill has forwarded to the California Academy of Sciences some dry *Virgularias* (?) from San Diego, California. Although the genus cannot be determined without alcoholic specimens, yet the axes of these specimens, which are about a foot long, present no differences whatever except in size, from the Burrard's Inlet specimens, of which the Academy possesses a large series. Mr. Hemphill adds in a letter to Mr. Stearns, to whom I am indebted for this information, that these animals, though not attached to anything, are quite hard to pull out of the mud, and that they descend into it at low water, protruding the upper portion of the polypidom only at high water. It is manifestly improbable that the Burrard's Inlet species, which attains an axial length of six feet, can thus conceal itself, and this would confirm the reports which have been circulated here, that it is found only in deep water.— W. H. D.

Absence of Eyes in Crustacea.—In connection with the subject of cave life and the probable derivation of the blind crayfish of Mammoth cave from ancestors able to see, we would refer our readers to the following remarks of Prof. Wyville Thomson in "Nature," May 15, on *Deidamia leptodactyla* von Suhm, dredged in lat. 21° 38′ N., long. 44° 39′ W. in 1900 fathoms. It is allied to Astacus, but differs from all the typical decapods in the total absence of eye-stalks and eyes.

"The absence of eyes in many deep-sea animals and their full development in others is very remarkable. I have mentioned ("The Depths of the Sea," p. 176)., the case of one of the stalk-eyed crustaceans *Ethusa granulata*, in which well-developed eyes are present in examples from shallow water. In deeper water, from 110 to 370 fathoms, eye-stalks are present, but the animal is apparently blind, the eyes being replaced by rounded calcareous terminations to the stalks. In examples from 500 to 700 fathoms in another locality, the eye-stalks have lost their special character, have become fixed, and their terminations combine into a strong pointed rostrum. In this case we have a gradual modification, depending apparently upon the gradual diminution and final disappearance of solar light. On the other hand, *Munida*, from equal depths, has its eyes unusually developed and apparently of great delicacy. Is it possible that in certain cases, as the sun's light diminishes, the power of vision becomes more acute, while at length the eye becomes susceptible of the stimulus of the fainter light of phosphoresence? The absence of eyes is not unknown

among the Astacidæ. *Astacus pellucidus*, from the Mammoth cave, is blind, and from the same cause — the absence of light; but morphologically the eyes are not entirely wanting, for two small abortive eye-stalks still remain in the position in which eyes are developed in all normal decapods. In *Deidamia* no trace whatever remains either of the eyes of sight or of their pedicels."

Ocelli in Butterflies.—Forty years ago, Klug, in a memoir on the occurrence of ocelli in insects, remarked that these organs were not found in butterflies, — "not even in Hesperidæ;" and so far as I know this has been the universal testimony of naturalists. It was therefore, with some surprise, that on removing the scales from the head of *Lerema Accius* ♂, I discovered in the middle of the front, a conspicuous ocellus. Other species were examined with the following result: Ocelli are present in both sexes of *L. Accius*, in the ♂ at least of *L. Pattenii* (no ♀ examined), but in neither sex of *L. Hianna!* I could not find any in the neighboring genera. In the ♂ of *L. Accius* and *L. Pattenii* there is a single ocellus — lenticular and smooth; in the ♀ of the former it is similarly situated, but broken up into three minute raised points, all together equal to the one ocellus of the ♂ and indicating that the latter is composed of three confluent ocelli.

It is not a little remarkable that in other Lepidoptera possessing ocelli, these are always two in number, and situated behind the antennæ, probably (I am unable to examine specimens) upon the vertex. In some Hemiptera, however, the ocelli are found below the eyes, and in others above, so that this feature is not unprecedented. It would scarcely seem as if the position of the ocelli had the same morphological significance as that of the other organs.—S. H. Scudder.

On a Habit of a Species of Blarina. — I recently placed a water-snake (*Tropidonotus sipedon*) of two feet in length, in a fernery which was inhabited by a shrew, either a large *Blarina Carolinensis* or a small *B. talpoides*. The snake was vigorous when placed in the case in the afternoon and bit at every thing within reach. The next morning the glass sides of his prison were streaked with dirt and other marks, to the height of the reach of the snake, bearing witness to his energetic efforts to escape. He was then lying on the earthen floor in an exhausted state, making a few ineffectual efforts to twist his body, while the *Blarina* was busy tearing out his masseter and temporal muscles. A large part

of the flesh was eaten from his tail, and the temporal and masseter muscles and eye of one side, were removed, so that the under jaw hung loose. The temporal was torn loose from the cranium on the other side, and as I watched him, the *Blarina* cut the other side of the mandible loose, and began to tear the longicolli and rectus muscles. His motions were quite frantic, and he jerked and tore out considerable fragments with his long anterior teeth. He seemed especially anxious to get down the snake's throat (where some of his kin had probably "gone before"), and revolved on his long axis, now with his belly up, now with his sides, in his energetic efforts. He had apparently not been bitten by the snake, and was uninjured. Whether the shrew killed the snake is of course uncertain, but the animus with which he devoured the reptile gives some color to the suspicion that he in some way frightened him to exhaustion.—E. D. Cope.

Births at the Central Park Zoological Garden. — Lion (*Felis leo*). Two cubs born January 25, 1873 (this is the second time that lions have bred on the Park); period of gestation sixteen weeks; the body indistinctly spotted, long black hairs being scattered over the head; born blind.

Lions are more prolific than any other species of Felis; after the first litter the number produced is seldom less than four. It is a well known fact, that these animals breed more freely in travelling menageries than in zoological gardens, the change of air no doubt having considerable influence in producing this result. The Director of the Dublin Zoological Gardens has been more successful than any other Director in Europe in breeding lions. They have never been able to raise young lions in the London Zoological Gardens. Dr. Bartlett, the Superintendent of the Gardens, in a paper read to the Society, says: —

"A very extraordinary malformation or defect has frequently occurred among the lions produced during the last twenty years, in the Regent's Park. This imperfection consists in the roof of the mouth being open. The palatal bones do not meet, the animal is unable to suck, and consequently always dies. This abnormal condition has not been confined to the young of any one pair of lions; but many lions that have bred in the Gardens, and were not in any way related to each other, have from time to time produced these malformed young, the cause of which appears to me quite unaccountable."—W. A. Camden, *Director*, *Central Park Menagerie.*

Generation of Eels (Anguillæ).— This is a subject that has occupied the attention of naturalists from the earliest dawn of Ichthyology; and its importance, both in a physiological and economical point of view, has always been, and still is recognized. Yarrell, in Jesse's "Gleanings in Natural History," and in the second edition of the "History of British Fishes," Vol. 2, p. 388, expresses his belief, as the result of a close examination of a number of eels, that they are oviparous, producing their young like other true bony fishes; and he refers in support of this opinion, to some Hunterian drawings, on a magnificent scale, by Clift. Dr. Mitchell, too, of New York, coincides strictly with Yarrell. Though hermaphrodites in fishes have hitherto been supposed to occur only abnormally, as in the genus Serranus, they may perhaps be more common and regular than is admitted in the books of comparative anatomy, such as that of Owen, wherein fishes are said to be always diœcious. But now an Italian physiologist, G. B. Ercolani, in the Proceedings of the "Accademia delle Scienze di Bologna," of last December, describes "Perfect Hermaphroditism in the Eel;" the genitals only completely developed at sea during the month of December; ovaries and testes then and there with spermatozoa; and, as he believes, the spermatozoa are discharged into the peritoneal sac, and the ova there fertilized before their emission from the body. This is surely an interesting statement, and in conformity with many facts well known regarding the economy of the eel. But it requires confirmation, and indeed the subject is so very curious and important, that it is to be hoped that ichthyologists on the seacoast will pursue the inquiry to its legitimate conclusion. —*Land and Water.*

Anatomy of the King Crab. — M. Alphonse Milne-Edwards finds that the circulating apparatus of Limulus is more perfect and complicated than that of any other articulate animal. The venous blood, instead of being diffused through interorganic lacunæ, as in the crustacea, is, for a considerable portion of its course, enclosed in proper vessels with walls perfectly distinct from the adjacent organs, originating frequently by ramifications of remarkable delicacy, and opening into reservoirs which are for the most part well circumscribed. The nutritive liquid passes from these reservoirs into the branchiæ, and, after having traversed these respiratory organs, arrives, by a system of branchio-cardiac canals, in a peri-

cardiac chamber, then penetrates into the heart, of which the dimensions are very considerable. It is then driven into tubular arteries with resistant walls, the arrangement of which is exceedingly complex, with frequent anastomoses, and of which the terminal ramifications are of marvellous tenuity and abundance. He has also found, as Prof. Owen had intimated, that the nerves are completely ensheathed by the blood vessels. — *Annals and Mag. Nat. History, Feb.*, 1873.

THE ROSE-BREASTED GROSBEAK (*Goniaphea Ludoviciana*).—I wish to testify to the benefits this bird confers by destroying the "Colorado Potato Bug" (*Doryphora decem-lineata* Say), cutworms, and other insects. I have often seen the birds feeding in company with robins, bluebirds, orioles, tanagers and other birds, in various parts of the state, where they appear to be abundant, particularly in spring. They frequent open timber, fields and ploughed lots away from travelled roads. Their note resembles that of the scarlet tanager; when flying, the white on the wings causes them to look something like the red-headed woodpecker. I have never known them to eat green peas, as Mr. Allen says that the black-headed grosbeak, their nearest ally, does. — HENRY H. MAPES, *Kalamazoo, Michigan.*

CANARIES NESTING.—Confined by illness I have for several days watched a pair of canaries making their nest. They are now lining it, using feathers for that purpose, a portion being from their own bodies, though not (I think) purposely detached. The rest are feathers which I have put on the bottom of the cage. I was struck with this observation, that every time a feather was taken to the nest, it was first deliberately dipped into the water cup, then put in its place, when the building bird, most frequently the female, would drop into the nest and then wriggle the body, to give shape to the structure. The soaking of the feathers was evidently a matter of design, namely, to cause them to lie in place, and receive the proper bend from the motion of the bird's body. I think this indicates considerable intelligence in these little pets.—S. LOCKWOOD, *February* 14.

AN AQUATIC BOMBYCID MOTH. — Mr. Bar of Cayenne has forwarded to the Entomological Society of France, descriptions and specimens of the various stages of an interesting Bombycid. The larva lives under stones in streams and rises to the surface for

transformation. The cocoons are found in clusters floating on the water. Aquatic caterpillars have hitherto been known only in the lower families of Lepidoptera.

THE EDUCATION OF APES. — The following query comes from a "layman," but is worth considering:—

"Suppose a man whose wealth corresponded with his love for scientific investigation, or some liberal institution or government in his place, should commence the following experiment, viz.; the careful education of a family of the most intelligent apes, through generation after generation, with a view of determining whether such a system would result in an increased development of brain, both in size and quality, and in the retention by one generation of knowledge acquired by a former. Of course this must be done in the native land, in a climate adapted to them, and with extreme and constant care, and the result in the life-time of one man might be hardly perceptible. Would not such an experiment, however, be of immense consequence to science however it might result?"

FAULTY INSTINCT IN A CAT.—Having ended some incomplete studies last summer on a pine snake, it became a question how to dispose of it for the winter, so as to have it in condition for renewed observations at the returning season. This was done thus. Its box was neatly covered, and converted into a flower stand, so that in blissful ignorance our lady visitors were not horrified, when admiring the sitting room flora, with any suspicion of a terrible "snake beneath the flowers."

We have a cat, which, already adult, was brought from "The Pines," and doubtless had a knowledge of snakes, probably both by inheritance and acquaintance. Yesterday, March 2d, the reptile set up its peculiar blowing in its dark box. It was a sight to observe the actions of the cat. There was plainly astonishment in that feline pate. She kept her place, turning her head towards the several corners of the room, and listening intently. Still continued that strange blowing of the snake, like a loud wheezing of wind escaping from a rent in a great forge bellows. The cat now fixed her eyes on the box whence the sound came. It happened that a strip of dark colored cloth lay on the box, with a part pendent to the floor. Pussy's mind was made up—that was a snake—nothing surer, for the sound kept steadily coming from that very spot. Now the cat crouched low and crept very slowly indeed, with eyes riveted on the prey. Still the reptile hissed and the cat slowly advanced. Now came a pause of but a second, and

the beast sprang seizing the pseudo-snake. There was an attempt at a shake; but its illusion had vanished. Such a look of silly astonishment and feline disappointment as followed cannot be described. All that can be said is, this new experience had its manifestation. As sometimes with other hunters, pussy's prey was not worth the powder, and she turned away in disgust. The exact nature of her perplexity we cannot know; for still the hissing was kept up. Although decidedly at fault in its attack on the strip of cloth, yet this whole affair seems to me a case of awakened instinct. It is a year and a half since she has been here. How much of recollection of individual knowledge, or experience; and how much of awakened inherited habit, or instinct, and what the concatenation of these things might be in that feline thinking, are perhaps problems to be referred to some future metaphysicist in zoology. One curious habit of this cat deserves mention. Her cry, whether caused by want of food or any other attention, is exactly that of our American puma (*Felis puma* Shaw) popularly known as the panther or painter. I have heard the female puma's cry so piercing and distressing, and the likeness is so close, that the sound of pussy's cry is positively annoying to me. The difference between them is entirely one of loudness. Even the very timbre, or quality of tone is identical. The cat is black and white and in disposition as gentle as others, even showing affection. I ought to say that when a kitten she was a favorite of my lamented friend, that accomplished botanist, the late Dr. P. D. Kineskern, and even in the pains of his departure her kitten gambols on his bed entertained that good and excellent man, who is known in posthumous fame as the philosopher of the Pines.—SAMUEL LOCKWOOD.

VARIATION IN DENTITION.—Mr. Allen and others may be interested in a case showing that even the dental formula, so universally employed in framing generic and higher groups of mammals, is variable, and therefore not always reliable. In the skull of a wolf (*Canis lupus* L., race *occidentalis* Rich., strain *griseo-albus* Bd.,) I find the dentition not only anomalous, but also asymmetrical; there is a supernumerary tooth on the right side of the lower jaw. The extra tooth is a molar behind the last true molar, making three teeth back of the large sectorial one. It is small (about as much less than the last true molar as this one is less

than the penultimate), but well developed, single-rooted, circular, very obtusely conical. There is nothing to meet it above, since it sets entirely back of the upper series. On the other side of the under jaw there is a slight pit in the bone, corresponding to the situation of the extra molar, and showing an ineffectual *nisus* in the same direction. In all other respects the dentition is normal. To judge from a limited experience, this is an uncommon anomaly; I have never before met with it in a feral animal. The preparation (No. 2,728 of the writer's coll.) goes to the Smithsonian. —ELLIOTT COUES, *Fort Randall, Dakota.*

HOW TO CLEAN THE EUPLECTELLA.—This beautiful sponge is becoming a favorite, and deservedly, with lady collectors. Its marvellous delicacy and purity, after long exposure without a glass shade, becomes sadly injured by the adhering dust. I had a specimen given me lately, which, from this cause had become so unsightly as to be accounted worthless. I filled a deep jar with water, and stirred into it a good table spoonful of chloride of lime. An hour or so was then given for the lime to settle. After this, the specimen, held by a clean thread, was suspended in the fluid for twelve hours or so. It was then taken out by the thread, and suspended a few hours in clean water. This entirely removed the chlorine. It was then suspended in the air to dry, after which it was of immaculate whiteness, and sparkled like the frosted snow.—S. L.

WOODPECKERS TAPPING SUGAR TREES.—Upon the Iowa University campus we have a number of grand old aboriginal oaks, a favorite resort for redheaded woodpeckers (*Melanerpes erythrocephalus*). Among the young and growing trees that have been transplanted upon the campus are some sugar maples (*Acer saccharinum*) the bodies of which are six or eight inches in diameter. Seeing the woodpeckers busily tapping upon them I examined the trunks and found them perfectly sound, but the birds had pierced many holes, of the usual size, through the bark and into the cambium layer, where they stopped. The sap was flowing freely from the holes, and, watching the movements of the birds afterward upon the trees, I became convinced that they were sucking the sap and that they had pecked the holes for the purpose of obtaining it. This habit is probably not new to ornithologists, but I am not aware that it has before been noticed.—C. A. WHITE.

THE WHITE-RUMPED SHRIKE.—In a residence of two years in central and southern Iowa, I killed a large number of shrikes, and although the greater number were plainly referable to *Collurio excubitoroides*, there were some that I could not satisfactorily place as belonging either to *C. excubitoroides* or *C. Ludovicianus*,—they seemed to be intermediate between the two; generally nearer the former than the latter. Occasionally an individual would agree very nearly with Baird's description of *C. Ludovicianus*, though without undoubted specimens of the latter bird from the southern states, I was unable to decide whether they were absolutely identical, or in what the difference consisted. I mention this fact to show that, while occasional observations, or observations for a limited space of time, would probably result in the conclusion that *C. excubitoroides* was the only form, close and extended observation would show a strong variation in many cases toward the *C. Ludovicianus* type, while rarely a specimen would be found that would appear to be absolutely of that species. Nevertheless, the typical *excubitoroides* is the predominating, and by far the commonest, form; nor could I observe anything in the habits of the birds pointing to two species or even well-defined varieties; birds mated together sometimes showing considerable differences of plumage.—T. MARTIN TRIPPE, *Orange, N. J.*

TADPOLES IN WINTER.—An esteemed contributor sends us an account of tadpoles that were found early this spring, having passed the winter in that condition, which he considered as perhaps a case of arrested development. It is however well known that the large bull frog (*Rana pipiens*) is (at least in the New England States) two or three years in the larval or tadpole condition, and if retained in a tank and forced to keep up its fish-like life there is no knowing how long the larval state would be retained. The experiments made by Prof. Wyman several years since resulted in keeping the tadpoles for a number of years, and at the end the water was accidentally let out of the tank. If any one will take the trouble of trying the experiment it will probably be found that unless the tadpoles are allowed a chance to hop along shore about the time their legs are developed, they can be greatly retarded in obtaining their perfect form as frogs or toads. Many of our New England species of frogs and toads develop very rapidly, passing through the tadpole condition in a

week or two, while others are naturally much longer in making the change, and probably both *Rana fontinalis* and *Rana pipiens*, 'and perhaps other species, require to pass one or two winters in the tadpole state.—F. W. P.

THE GOLDEN-WINGED WOODPECKER.—In his "Notes of an Ornithological Reconnoissance of portions of Kansas, Colorado, Wyoming, and Utah," J. A. Allen speaks of specimens of *Colaptes auratus*, taken in eastern Kansas, showing a tendency to the coloration of *C. Mexicanus* in having the "black maxillary patch, more or less tinged with red;" and mentions one from Florida with the same peculiarity. I have observed red feathers in the cheek patches of birds shot at Orange, N. J., in three or four instances; and in one case the black was quite thickly sprinkled with small specks of bright, shining red, more brilliant than that of the nape. Here we have an instance of occasional individuals of one species exhibiting a tendency to vary in the direction of a congeneric species, not occurring within fifteen hundred miles of the former.—T. MARTIN TRIPPE, *Orange, N. J.*

ORNITHOLOGICAL QUERIES.—I wish to make two or three ornithological queries through the pages of the NATURALIST. What are the southernmost localities in which the following species are known to breed? viz: *Regulus satrapa*, *R. calendula*, *Anorthura hyemalis*, *Junco hyemalis*, *Plectrophanes pictus*, *P. Lapponicus* and *P. nivalis?* What is the eastern limit of *Vireo Belli?* and what is the southern and southwestern range of *Pediœcetes phasianellus?* I am very desirous of obtaining information on these points.—T. MARTIN TRIPPE, *Orange, N. J.*

MODE OF EGG-LAYING OF AGRION.—Mr. G. W. Dunn writes us that while collecting at Santa Cruz, California, he observed a species of Agrion (as we find the insect to be) "flying about the water united male and female. The female would light on a spear of grass growing in the water; the male would then let go, and the female go down the grass twelve or fifteen inches under water and deposit her eggs."

HABITS OF MONOHAMMUS DENTATOR.—On the 9th of June, 1872, my attention was directed to a yellow pine (*Pinus mitis*) about fifty feet high and twelve inches in diameter, in which several

holes about the size of a pencil were to be seen at various points on the trunk.

On removing the bark I found an adult insect already free and the heads of several others appearing through the wood. On further investigation during the next few weeks I obtained from the tree no less than eighty of these beetles in all stages of develop ment, which, considering the size of the tree, was a large number. I observed that the largest beetles were near the foot of the tree, and that the larvæ almost invariably avoided a knot on account of the hardness (?) of the wood. Where the diameter of the tree was about six inches the larvæ would bore through the trunk instead of making only a surface bore as they did where the diameter was greater.

The larva is a footless, yellowish white grub, more or less hairy, cylindrical in shape, and about one and four-tenths inches long, and three-twentieths of an inch in diameter. The body including thè head is made up of fourteen segments, the last eight of which have a kind of ridge on each side, covered with hairs longer than those which are found on the rest of the body and which doubtless assist it in locomotion, the second segment next the head is flattened on the upper side. On both the upper and under sides of the body are seven raised rough spots at right angles with the ridges on the sides. It feeds on the sap wood or inner bark until autumn, when it turns aside and bores outward leaving its passage filled with chips. Within the distance of from one-half to one-tenth of an inch from the bark it forms a smooth, hollow, curved excavation about the size of an almond in which it undergoes its transformations during the winter or even as late as the last of June.

The pupa is white and varies in size from three-fourths of an inch, to an inch and one-tenth. In this state it resembles the imago, the only difference being that the elytra are not developed.

After remaining in the pupa state during a space of time which varies according to circumstances it is transformed to a beetle and after a short time gnaws its way out, appearing from the first of June to the middle of July. The imago is brownish, mottled with gray, black, and cream color, and varies in size from three-fourths, to something over an inch in length. The two sexes differ in the great length of the antennæ, which in the male are full twice the length of the body, and in the development of the

anterior tarsi, which in the male are much broader than in the female. It is unnecessary further to describe the imago as in this state the dentator is well known. I have only taken these beetles in Massachusetts but have found traces of them in Connecticut and in northern New York, whence it can be inferred that they inhabit all New England. — F. C. Bowditch.

The Painted Bunting.—The *Plectrophanes pictus* visited southern Iowa last fall in great numbers, appearing toward the close of October, but whether it is as abundant every season I cannot say, but am inclined to think that it was far more common than usual, as was the case with almost all northern birds. In its habits it was very similar to the Lapland longspur, but differed in being less gregarious, frequently feeding singly or in small parties of five or six, which the latter bird seldom does, and in showing a partiality for wet meadows and moist low-lying prairie swales, while the longspur prefers the cornfields and higher ground, as a rule, and does not appear until some weeks after *pictus*. The notes and flight of the two species are quite similar, though distinguishable.—T. M. Trippe, *Garden Grove, Iowa.*

New North American Hymenoptera. — The last number of the Transactions of the Academy of Science of St. Louis contains a posthumous paper by the late B. D. Walsh, in which many new species of Tenthredinidæ, and Ichneumonidæ are described.

ANTHROPOLOGY.

Note on a Collection of Skin Scrapers from New Jersey.— Since the publication of our notice of the stone implements found in New Jersey, in the Naturalist for March and April, 1872, our attention has been frequently called to the greater variety of shapes than we then supposed to occur, and to the unusual degree of excellency exhibited in the manufacture of these well known relics. In the paper referred to, we figured four relics as scrapers, each bearing considerable resemblance to the others. In a collection of fifty-four specimens lying before us, we find five types; one of them is the English form, being thin flakes of jasper, of a uniform surface on one side, sloping to either side from a median ridge, and chipped to a bevelled edge in front. The three specimens bear considerable resemblance to those fig-

ured by Mr. Evans on page 273 of his "Ancient Stone Implements of Great Britain." Eleven of these scrapers, all of jasper, are triangular in outline, and of very beautiful finish; exceeding in beauty of form and careful workmanship any figures given by Mr. Evans. Of them, but two are bluntly ended, and but one without the characteristic bevelled edge of scrapers. The triangular form appears, as a rule, to have the scraping edge convex, the sides chipped to a cutting edge, and the implement itself, even when very small, appears to be chipped from a nodule of mineral, and not fashioned from a flake, as those just described. The variation in size of these triangular scrapers, as exhibited in this series, is from two and one-half inches in length by one and five-eighths inches in width, to seven-eighths in length by five-eighths in width. This smallest specimen is in all respects a very beautifully wrought specimen, having the bevelled, or "scraper" edge very distinctly chipped.

The form of scraper that is most usually met with, in our New Jersey "finds," is that which we have described in Vol. vi of the NATURALIST, pages 221–223, the figures of which we here reproduce (Figs. 131, 132, 133, 134). This type, which is a modification of the spoon-shaped scrapers described by Mr. Evans, appears to have been the favorite one among the Delaware tribes. There are twenty-one specimens in this little collection, all of which are carefully wrought, and but three of them are of slate. While in general appearance this form suggests the utilization of the bases of spearheads in their manufacture, we doubt very much, after examining a very large number, if this was the rule. We think, rather, that it was the exception, because this type of scraper very generally is thicker than spearpoints; the stem or handle is thinner than the blade; the upper side or that from which the bevelling proceeds is ridged, while beneath it is flat or nearly so; all of which shows a variation from ordinary spear and arrowheads, which could not have been produced by any chipping of the base of either of those implements. The implements figured in Vol. vi of the NATURALIST, pages 212 and 213, here reproduced as Figs. 135, 136, 137, we now believe to be scrapers and not spear or arrowpoints. The variation in size of this stemmed or modified spoon-shaped scraper is from three inches in length by two in greatest breadth, to one inch in length, by about seven-eighths in width. As in the preceding instance, this smallest

specimen is equally as well wrought as the larger, and varies from them only in having a notched base, rather than a narrow and straight stem. It is flat upon one side and convex upon the other, with a beautifully chipped bevelled edge. It certainly was made

Fig. 131.

Fig. 134.

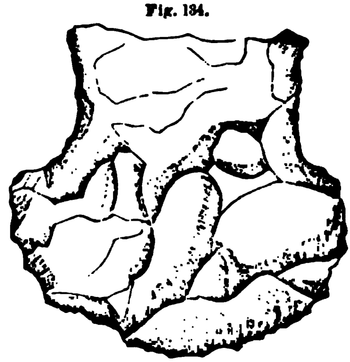


Fig. 132.

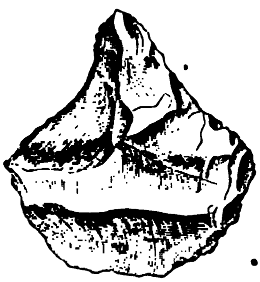


Fig. 133.

from a nodule of jasper directly, and not from a broken arrowhead, chipped into a scraper.

Another small specimen varies from the above in being of much greater width and of the same length. The edge in this case is bevelled from each side, so that the specimen may have been originally an arrowhead. The form of the implement suggests the blunt arrowheads described by Schoolcraft, as being employed by young boys when learning to use the bow and arrow; being made blunt that they might not pierce the target. This type of handled

scrapers varies somewhat in the relative widths of head and handle, so that the gradation to other forms, especially the triangular or kite-shaped, can be traced in every considerable collection.

The form of scraper described by Mr. Evans as "horseshoe-shaped" is represented in the series by seven specimens, while five others approach this type, and are, as it were, connecting

Fig. 135.

Fig. 136.

Fig. 137.

links with the preceding types. These twelve specimens are all of jasper, very well chipped over their whole surface, although not as smoothly wrought as the preceding and have well defined scraping edges along certain portions of their margins. In size they are about the same as the specimens figured by Mr. Evans, with probably a smaller proportion of the larger ones.

The spoon-shaped scraper, of which Mr. Evans figures a pretty specimen on page 277 of his work, is represented by three speci-

mens in our series, one of which is very similar to that referred to from the Yorkshire wolds. The others have the bowl of the spoon not so well defined, but otherwise are well made scrapers. There are also three other specimens, that might be more properly called knife-shaped scrapers, in that the bowl and stem or handle are of the same width. The scraping edge is, however, circular, as in the true spoon-shaped form. These may be looked upon as connecting links with the quadrangular or horseshoe-shaped scrapers. There remains one other specimen to notice, being a "side scraper," as Mr. Evans calls this form, that is, one that is broader than it is long. It is made of slate, chipped with some care; is two inches in length by three in width. Both sides are adapted to scraping, being each well chipped, with the lower side flatter than the upper surface. What perhaps might be called the true edge, is somewhat more extended than the other, from the barblike projections at either end, which barbs give a finished appearance to the implement, which otherwise might have been looked upon as merely a flake or unfinished specimen. This form of scraper is not common with us.

After a careful study of these and many other specimens of this form of implement, found in New Jersey, we have determined, we think:

First. That jasper, quartz and allied minerals were preferred in manufacturing scrapers.

Secondly. That as much care was taken in their shaping and finishing, as was the case with arrowpoints and spearpoints.

Thirdly. That but few "flakes" were utilized in making scrapers, as is the case with European specimens.

Fourthly. That the majority of scrapers were intended to be inserted in handles of bone or wood.

Fifthly. That large spearheads especially, and some arrowheads were used for making scrapers, having previously lost their points, and being too short to be repointed.

Lastly. That, as a class, the New Jersey scrapers are smaller than those found in Europe.—CHARLES C. ABBOTT, M.D.

MICROSCOPY.

IMPROVEMENTS IN OBJECTIVES.—Mr. Wenham has placed microscopists, and indeed all persons interested in scientific progress,

under a new obligation, by his last paper on object-glasses, contributed to the Royal Microscopical Society. He seems to be strangely unconscious of the fact that he cares more for human progress than for trade secrets; and he publishes, with the utmost apparent indifference, exactly what the world wants to know, but what it knows too well would be by most persons devoted to secrecy and to personal business purposes.

Introductory to an explanation of his new formula for objectives, Mr. Wenham reviews the history of the modern (English) objectives.

In the year 1829, before which time three superposed achromatic lenses were employed simply as a means of increasing power, the late Mr. Lister discovered and published the law of aplanatic foci, that by separating suitably connected lenses one or two positions could be found in which spherical aberration was balanced; and Mr. Ross constructed in 1831, with unexpected success, the first objective embodying this principle. Mr. Ross then discovered that the interposition of a cover-glass removed the aplanatic focus to a different plane, causing negative aberration and requiring the lenses to be brought closer together; and he therefore introduced the screw collar adjustment which has now become universal. These objectives consisted of three pairs, the double convex crown and plano-concave flint of each pair having their contact surfaces of equal radius and balsamed together, the three pairs having foci about in the proportion of one, two, three, and the anterior pair being at a considerable and variable distance from the other two pairs. In this combination the softness of the flint glass forming the first plane surface was unfortunate, and the angular aperture of a $\frac{1}{8}$ was limited to 60°.

In the year 1837, Mr. Lister furnished Mr. Ross a diagram of a triple front lens, consisting of a plano-concave of flint between two plano-convex crowns, for the purpose of protecting the flint from the exposure to the air and of diminishing the depth of curvature, which was unfavorable for the passage of the marginal rays. The front surface of the middle pair was made concave with no other advantage than reducing the depth of contact, and it may be made a plane with at least equally good results in correction of the oblique pencils and in flatness of field. An angle of 80° was attained, by this method, in one-eighths.

Thirteen years later Mr. Lister introduced the triple-back, for the same objects as the triple front, it being composed of a double concave of very dense flint between a plano-convex and a double convex of crown. Thus more marginal rays were collected, and the aperture of a $\frac{1}{8}$ raised to 130° or over.

At that time Mr. Wenham, experimenting in the construction of objectives, discovered that excessive over correction or negative aberration was easily obtained with lenses of shallow contact curves, and that color correction was chiefly controlled by changes in the triple back, the rays passing through the concave flint of the triple front so nearly in the direction of its radii that great changes in its curvature possessed only feeble chromatic effects. This led him to introduce the now familiar single front of plano-convex crown glass which was long rejected by the leading opticians, but is now used by all of them. The first $\frac{1}{8}$ constructed on this system possessed an angular aperture of 130°, and was successful at first attempt, the middle pair being neutral or nearly achromatic and the triple back happening to have a suitable excess of negative aberration or over correction for color. Some positive spherical aberration remained, which was remedied by giving additional thickness to the front lens; a correction now considered essential and requiring great delicacy, as a difference in thickness of $\frac{1}{500}$ inch will determine the quality between a good and an indifferent $\frac{1}{15}$.

The excessive depth of the contact surfaces of the middle pair was a remaining defect, it being so great that if not balsam cemented, total reflection of the marginal rays would take place, and the angular aperture be reduced. Though the surfaces are obliterated by being cemented with balsam and the rays are thus enabled to proceed, still an angle beyond that of total reflection, implies excessive and detrimental depth of curvature. Placing the flint in the form of a meniscus above a plano-convex crown was employed as a middle pair with some satisfaction. An attempt was also made to obtain the whole chromatic correction with the biconcave flint of the back, the middle as well as the front being a single uncorrected plano-convex of crown. Sufficient over correction was obtained by the back to balance both the other lenses, but the red and blue rays, for instance, had become so widely separated in the front and middle lenses and between them when placed for aplanatic foci, that they could not be brought

together again at the point of leaving the back lens, and must either leave it converging to some one fixed conjugate focus, or else parallel but not united; in the first case the combination could only be applicable to one fixed length of body, and in the other it would not be satisfactory under any conditions. The cure for this seemed to be, and proved to be, to transpose the single middle and the triple back; the over corrected triple bringing together the rays which had been separated by the single front, and the single lens of longer focus making the rays parallel at the point of final emergence. The single front is nearly alike in all cases, varying only with the power required; the triple middle is of about three times, and the single plano-convex back four and a half times the radius of the front. The single plano-convex of long focus is reversed when transferred from the middle to the back position, the plane surface being above instead of below. Perfect color correction can be obtained by this formula in all screw collar objectives, from $\frac{1}{2}$ inch upwards. This combination consists of five lenses and ten surfaces, taking the place of eight lenses with sixteen surfaces.

These results are worked out by diagrams more easily than by mathematical computation; the course of the rays being projected by means of proportional compasses, with surprising accuracy, on a scale of some fifty times the size of the real combination.

Tolles' Triplets. — A correspondent writes as follows regarding a half inch triplet lately made by Mr. Tolles. "I am greatly pleased with the lens. Its performance is *splendid*, and it really gives the naturalist when away from his microscope an extraordinary facility. I should be very sorry to be without it." We quote this from our friend's letter, which was by no means designed for publication. These triplets certainly surpass anything of the kind we have met with. Mr. Tolles has just finished a $\frac{1}{75}$ objective, which is perfectly satisfactory to himself.

NOTES.

It is seldom that the sad record we are now obliged to make occurs in a single number of a magazine: — the loss by death of four valued contributors within so short a time.

Prof. John Lewis Russell, of Salem, died on the 7th of June, in the 65th year of his age. Prof. Russell was one of the founders,

and for many years the president, of the Essex County Natural History Society, which afterwards became part of the Essex Institute. He was an active worker in botany, and though he never published the results of his labors to any great extent, he has for years been considered as an authority in New England cryptogamic botany to which he devoted most of his attention. Of a peculiar and retiring nature, he never made himself prominent among the scientists of the day, though by those who knew him intimately his learning was held in great respect. As a popular exponent of botanical subjects he was much appreciated.

Mr. GEORGE GIBBS, the distinguished American ethnologist and philologist, died at New Haven, on the 9th of April, in his fifty-eighth year. Mr. Gibbs, though a lawyer by profession, has been an extensive contributor to various departments of natural science, as well as to literature, but his special work since 1849, when he first visited the Pacific coast, has been in researches relative to the languages and history of the North American Indians. Since this period he has filled several important posts as geologist on several of the government surveys and added much to our knowledge of the geology and zoology of the western portion of our continent. At the time of his death he was engaged in superintending the printing of a quarto volume of the Smithsonian Contributions, containing several hundred series of Indian vocabularies which he had arranged in a most critical manner. We understand that this last work of Mr. Gibbs was so far perfected, that its completion will be entrusted to Dr. Roehrig who was assisting in the work.

Col. JOHN W. FOSTER, President of the Chicago Academy of Science, died at Chicago on the 29th of June, aged 58. Col. Foster, though an active laborer in science for many years, is perhaps best known as the joint author with Prof. Whitney of the government Report on the Mineral Lands of Lake Superior, published in 1850, and from his volume on the Mississippi Valley published a few years since, though he has contributed many papers and memoirs on geological and archæological subjects. He contemplated a series of articles on the "Mound builders of the Mississippi Valley" for this magazine, two of which were published, when his time became fully occupied in the preparation of a more extensive work on the subject, which was issued but a few weeks before he died. He was one of the original members

of the American Association for the Advancement of Science, of which he was president at the meeting held in Salem in 1869, and for many years has taken an active part in the proceedings of the Association.

Prof. HENRY JAMES CLARK died at Amherst, on July 1st, at the age of forty-seven. Prof. Clark first became known to the scientific world as a very promising student with Prof. Gray. He afterwards, and for twelve years, was associated with Prof. Agassiz as an assistant. In 1860 he was made adjunct professor of Zoology at Harvard, and afterwards held professorships at the Agricultural College of Pennsylvania, the University of Kentucky, and finally in 1872, at the Massachusetts Agricultural College at Amherst, where after much suffering his useful work was terminated. Prof. Clark was probably the most thorough histologist in this country, and was our best microscopist in the general acceptance of the term. His volume entitled "Mind in Nature" published some ten or twelve years since was the result of his micro-physiological studies. He was a large contributor to Prof. Agassiz' volumes on the Natural History of the United States, and he has also printed many important papers in the Memoirs of the American Academy, the Boston Society of Natural History, and various scientific journals. We understand that the Smithsonian Institution was publishing an extensive work by Prof. Clark, which we trust will not be delayed by his death. Prof. Clark was a member of the National Academy of Science and of the leading scientific societies in the country.

IT appears that the scientific results of the voyage of the Polaris, as revealed by the examination by the Secretary of War of Capt. Tyson and his comrades, when the vessel is rescued, as there are strong hopes she will be, promise to be very encouraging to the advocates of farther arctic explorations. The Polaris reached 82° 62′ north, where she was in the new straits she had discovered. The dredge was not used, but the records of the astronomical, meteorological, magnetic, tidal, and other departments of exploration appear to have been full, while the collections of natural history, including skins and skeletons of musk oxen, bears and other mammals, birds and eggs, marine invertebrates, plants and fossils, were very numerous.

Specimens of drift wood of the walnut, ash and pine were said

to have been picked up near the shores of Newman's Bay and Polaris Bay. On the shores of the latter bay in lat. 81° 38′ N. Capt. Hall "found that the country abounds with live seals, game, geese, ducks, musk cattle, rabbits, wolves, foxes, bears, partridges, lemmings, etc., etc."

The geographical results of the Polaris expedition, so far as they can now be ascertained from the testimony of Messrs. Tyson, Myers and their comrades, may be summed up briefly as follows. The open Polar sea laid down by Kane and Hayes is found to be in reality a sound forming an expansion of Kennedy channel to the northward and broken by Lady Franklin Bay on the west, and on the east by a large inlet twenty miles wide at the opening and certainly extending far inland. Its size was not ascertained, and Mr. Myer thinks it may be in fact a strait extending till it communicates with the Francis Joseph sound of the Germania and Hansa expedition, and with it defining the northern limits of Greenland. This inlet was called the southern fiord. North of it is the indentation of the shore called Polaris Bay by Captain Hall, where the Polaris wintered in lat. 81° 38′ north. The northern point of this bay was named Cape Tupton. Its southern point is yet without a name. From Cape Tupton the land trends to the northeast and from the eastern shore of a new channel from twenty-five to thirty miles wide opening out of the sound before mentioned. The trend of land continues to Repulse Harbor in lat. 82° 9′ north, the highest northern position reached by land during this expedition. From an elevation of 1700 feet at Repulse Harbor, on the east coast of Robeson's Straits, the land continues northeast to the end of these straits, and thence east and southeast till lost in the distance, its vanishing point bearing south of east from the place of observation. No land was visible to the northeast, but land was seen on the west coast, extending north as far as the eye could reach, and apparently terminating in a headland 84° north. Mr. Myer also stated that directly to the north he observed, on a bright day, from the elevation mentioned, a line of light, apparently circular in form, which was thought by other observers to be land, but which he supposed to indicate open water. Besides ascertaining accurately the condition and extent of what was before supposed to be an open polar sea, discovering the southern fiord to the southeast, and Roberts's Straits to the north, with another wide expanse of water beyond it and ex-

tending by examination and survey the coast line on the east up to latitude 82° 91′ north, and by observation somewhat farther prolonging the west coast to the northward and passing with the Polaris under steam the high latitude of 82° 16′ north — a point far beyond the limits of all previous navigation toward the pole— errors in the shore line of the west coast as laid down by Dr. Hayes, and also errors in the shore line of Greenland as laid down by Dr. Kane, were observed and corrected.

Mr. Clement R. Markham writes to "Nature" that from the results gleaned from the story of the boat's crew of the Polaris, there are renewed and strong arguments for the fitting out of an English arctic expedition, which has been urged for a year or two past.

The government has dispatched two vessels in search of the Polaris, with a good prospect of finding her and saving the valuable journals and specimens aboard.

Prof. C. A. White of Iowa State University and State Geologist of Iowa, has been appointed Professor of Geology and Natural History at Bowdoin College. This is a new chair, and its establishment shows that the interest in science that has always characterized this college is on the increase. The Cleaveland Cabinet of Natural History at Bowdoin College was dedicated July 10. The museum, formerly Massachusetts Hall, has a very handsome interior. The address was delivered by Hon. Nehemiah Cleaveland, and remarks were made by other gentlemen present.

The bryological books and exceedingly rich and important collections and preparations of mosses left by the late W. S. Sullivant are to be consigned to the Gray Herbarium of Harvard University, with a view to their preservation and long-continued usefulness. The remainder of his botanical library, his choice microscopes, and other collections are bequeathed to the State Scientific and Agricultural College, just established at Columbus, and to the Starling Medical College, founded by his uncle, and of which he was himself the senior trustee.

The Topeka Scientific Institute is the title of a society in Topeka, Kansas, two years old, devoted to general science. It closed for the season on April 18, having sustained a free course of popular scientific lectures during the winter.

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THE

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"CONTROLLING SEX IN BUTTERFLIES."

BY CHAS. V. RILEY, M.A.

THE article with the above title by Mrs. Mary Treat, in the March number of the NATURALIST, has attracted a good deal of attention, and most naturalists will be proud that a lady has set the example of making such investigations. But while I fully concur with the authoress in the deduction that the female in insects and especially in Lepidoptera, "requires more nourishment than the male," I cannot follow her in the other conclusion "that sex is not determined in the egg of insects." Were this conclusion well founded it would upset what most physiologists of note believe to be a fundamental principle, viz., that, in the individual, sex is determined at the moment of conception, no matter at what stage of growth it becomes ascertainable by us. That such is the case with the higher animals will scarcely be doubted, and to reason from analogy that it is the case with the whole animal kingdom is quite as natural, though equally as unsafe, as it was in years gone by to argue that *lucina sine concubitu* was an impossibility; or that larval reproduction, in insects, could not possibly take place. It is, therefore, worth while to weigh the evidence for and against the possibility of controlling sex in larvæ.

Mrs. Treat, whom I know to be a good observer, and whom I esteem as a correspondent, had already, in 1871, communicated to me her belief that she could control the sex in butterfly larvæ,

and though I then gave her my opinion that her experiments were by no means satisfactory and conclusive, for the reason that many of the larvæ experimented on died, we find her discoursing in the following unqualified manner in "Hearth and Home" for January 13, 1872, in treating of *Papilio asterias*:—

"When the worms become of the right size cut off their supply of food, and every one will produce a male butterfly! On the other hand even after they have left their food-plant and selected their place to change to the chrysalis, disturb them, make them leave their place, and coax them with a fresh supply of their favorite food, and continue to feed them for about two weeks longer, and all will be females!"

Led by Mrs. Treat's observations to test the question, I last summer conducted a few experiments which resulted very differently from those recorded in the article referred to, and which, after briefly reviewing the article, I will detail. In waiting for some of these results I have been obliged to defer writing this article till the present time.

In the first experiment with *Papilio asterias*, mentioned by Mrs. Treat, some of the larvæ died, and we are not told whether the number experimented with was large or small.

In the experiment with the same insect in 1872 we are told that of seventy-nine specimens that had been labeled males (a few chrysalides having died) three females only were produced. On the other hand those that were well "fed up" and labeled females, produced sixty-eight females and four males. The original number so labeled is not given and it is not stated whether any chrysalides failed to produce the imagines; so that we are left to infer that seventy-two were experimented with and that they all produced the butterfly — a success in rearing which is remarkable.

In the third experiment with twenty larvæ, nine females and eight males were produced, the other three failing.

In the experiment with *Vanessa antiopa* more than half the larvæ died, and in the trials with *Anisota rubicunda* some also died and were parasitized.

Now *Papilio** deposits its eggs singly, and from experience in breeding *asterias*, *Troilus*, *Turnus* and *Ajax*, from the egg, I am satisfied that it would be very difficult to get any great number to hatch on the same day or to become chrysalides or

* I use the term in the old, and not in Mr. Scudder's, sense.

imagines on the same day. The eggs must have been gathered singly, or the larvæ of different ages taken on the same day, or of the same age on different days. Of a given number thus gathered I should expect the sexes to be about equally divided, and we in reality find that of the one hundred and seventy-one larvæ, particularly mentioned, the sexes are almost equally proportioned in number, eighty-eight males and eighty females having been obtained and a few chrysalides (which, as we shall presently see, would most likely be females) perishing.

In *Anisota*, on the contrary, the eggs are deposited in batches and it is more easy to get a number of larvæ of the same age. Mrs. Treat's experience with her thirty-three larvæ is quite opposed to mine with the same species.

Mrs. Treat does not tell us whether she did or did not use any discretion as to the size in selecting her intended males and females, and this is a very serious omission, as by the criterion of size alone among larvæ of the same age, the sexes in many species may be separated with considerable certainty. I regret also that she has not specified at what age, and whether always at the same age, the treatment of "feeding up" and "shutting off" was begun, though we may infer, from what is said, that it was after the last larval molt.

Mrs. Treat speaks of keeping larvæ eating beyond the period of pupating, or rather of preparation for that change, and of "starving" them, as though there was hardly any limit to these processes. Analyzed, what meaning do these expressions convey? Very little. They are deceptive! Most Lepidopterous larvæ, in a state of nature would come under the head of "feeding up" as they usually have an ample supply of food at command, and eat their fill. While, therefore, it is perfectly possible to stunt such larvæ by furnishing them with a scant supply of food, and thus to prolong the period and diminish the amount of their development, it is utterly impossible, in the great majority of cases, to get them to eat after they once commence to prepare for the chrysalis state. This is my firm conviction after ten years of pretty extensive insect-rearing, and I think that most experienced insect-raisers will agree with me. If disturbed after preparing to pupate, most larvæ will repeatedly renew similar preparations, but if too often frustrated they will either transform without the proper preparation or die. They are, doubtless, prompted to forsake their food and

prepare for the transformation by the changes already taking place in the system, and in the great majority of cases the mandibulate is already giving way to the haustellate mouth, and has become impotent to perform its wonted labor. Larvæ can neither be forced nor stuffed beyond a certain limit, and this limit is attained by every well fed larva in a state of nature and in the vivarium, so that if Mrs. Treat's theory had any real foundation almost all insects that were not "starved" ought to be females. A high temperature will cause rapid development, but it does not cause a greater aggregate amount of feeding.

But to my own experiments: Of the six insects chosen, the sexes in some differ in the most remarkable manner, while all show sufficient disparity to render mistakes in separating the sexes impossible. They are, also, all common in this section, so that others will have no difficulty in verifying my facts. Except in the case of *Thyridopteryx* I made no attempt to "feed up;" my efforts all being in the direction of "starving," or, as Mrs. Treat would put it, of producing males. Neither have I relied entirely on my own observation; for, being necessarily absent from home, at intervals, the experiments, with explicit directions, were at such times left in charge of Mr. Otto Lugger and Miss Mary E. Murtfeldt, both well practised in rearing Lepidoptera. I would also premise that the stunting process began from the time of hatching, and that it was carried so far that, of the less hardy species, many died under the treatment. It was, also, especially enforced towards larval maturity. The species chosen were, 1. *Thyridopteryx ephemeræformis* (Haw.); 2. *Orgyia leucostigma* (Sm. and Abb.); 3. *Clisiocampa Americana* (Harr.); 4. *Hyperchiria Io* (Fabr.); 5. *Hemileuca Maia* (Drury); 6. *Anisota rubicunda* (Fabr.).

1. *Thyridopteryx ephemeræformis.*—Two lots: lot 1 consisting at first of between thirty and forty individuals, and abundantly and constantly nourished; lot 2, of thirty individuals and very poorly nourished or "starved." From lot 1, twenty-eight cocoons were obtained, of which fifteen were males and thirteen females, all of them attaining the imago state. From lot 2, eighteen cocoons were obtained, which produced twelve males and six females, two of the females failing to perfect and dying in the chrysalis state, in which the sex is readily determined. The stunted lot produced, on an average smaller specimens, and were later in developing, the first male appearing September 15th

against September 10th, on which day the first male in lot 1 appeared. Some of them, however, were of the usual size.

Besides these two lots which were in small vessels and very strictly watched, I had a great number in a large breeding cage, which were so thoroughly neglected that fully one-half died. No accurate account was kept of them but of upwards of fifty chrysalides obtained, fifteen were females. This is a tough insect and will stand very rough treatment, and the last-mentioned were repeatedly allowed to wander around the cage for three days or more without a particle of food.

2. *Orgyia leucostigma.*— Started with a lot of forty, which were very carefully watched and very insufficiently fed. From them eighteen cocoons were obtained, ten of which were actually females and eight males. I naturally looked for a different result in this case as there is a very perceptible difference in the size of the sexes, and the female larva grows one-third larger than the male requiring, in consequence, a greater amount of nourishment. I had also noticed in previous rearing of this species that the males often passed through but three larval molts, while the females passed through four; but to show that the number may vary in the same species, according to circumstances, Miss Murtfeldt assures me that under this stinting process the former went through four molts like the females. Similarly, Prof. Westwood has informed me that a larva of *Megatoma* [*Tiresias*] *serra* which he once kept on flies and insufficiently fed, lived for three years and molted no less than fourteen times.

3. *Clisiocampa Americana.*— Started with a batch of upwards of fifty just hatched. Obtained only nineteen cocoons from them, the rest dying from hard treatment. Five small females and nine males were obtained, the others dying in chrysalis.

4. *Hyperchiria Io.*— Twelve taken from Baptisia soon after the fifth or last molt. Furnished very stintingly with food. All pupated. Two male moths issued in the fall; four males and three females this spring, three being yet in the chrysalis state. At the same time I had two other lots feeding, with ordinary care, on Sassafras and Amorpha, and in both lots the males have so far preponderated.

5. *Hemileuca Maia.*— One brood of upwards of one hundred from an egg-belt fastened around a peach twig. Endeavored to feed them on peach leaves, which were not to their taste, until

more than half had died. Stinted the rest as much as possible until only thirty-two entered the ground. Of these fifteen produced males and eight females, the rest being yet chrysalides.

6. *Anisota rubicunda.*—About fifty larvæ of all ages, of the first brood, and badly stinted, gave twenty-two chrysalides; and these gave eleven females, seven males—the rest dying. Upwards of a hundred, hatched from eggs deposited in confinement by one of the above females and likewise stinted, gave fifty-six chrysalides.

I watched these with a good deal of interest, as, from the necessarily weakened condition of the parents, I expected a large proportion of males; but I was doomed to disappointment, as but three moths—two females, one male—issued on the 21st and 22nd of May. In examining the remaining chrysalides I find them all dead, and I cannot help thinking that this excessive mortality is attributable to the stinting process they endured as larvæ, more than to any other cause, as the earth containing them was kept in the best condition.

While these experiments were being carried on I had many hundreds of the common silkworm (*Bombyx mori*) feeding on Osage Orange (*Maclura aurantiaca*) a great number of which succeeded admirably out-doors under netting, and others in-doors. Two of the lots in-doors were fed sparingly and not well cared for. No precise records were kept, and very many died; but of the imagines obtained I recollect very well there was no disproportionate number of males.

On the whole, if these experiments indicate anything, they indicate that where more males than females are obtained from stinted larvæ, it is attributable to the fact that the females, being largest and requiring most nourishment, succumb most readily under such treatment; rather than that the sexual characteristics are modified and determined by such treatment. Mrs. Treat's facts are, in some respects, remarkable, but, bearing in mind the influence of the condition of the parents on the sex of the offspring, it will not do to draw conclusions too rashly; for every experienced entomologist knows that occasionally, in a particular brood of larvæ, one sex or the other will greatly preponderate, where no especial treatment was followed in the rearing.

While, therefore, I do not think that the facts yet in our possession, warrant the belief that the quality or amount of food has

any influence in determining sex in the individual once out of the egg, I do believe, with Thomas Meehan, Henry Hartshorne and others, that there is a certain relation between organic vigor and sex, and that the latter may be determined in the offspring by the amount of vigor or vitality — creative or organic force — in the parents, and that the female is in some way connected with increased, and the male with lessened, vitality; for strong arguments may be adduced in favor of such a belief.* Certain curious facts in the natural history of some of our gall-making *Cynipidæ* lend singular weight to these views. From these facts, ascertained by Mr. H. F. Bassett of Waterbury, Connecticut, there can be little doubt that many of the species produce two distinct kinds of galls, alternating with each other, the one vernal, the other autumnal. The former produce flies with a due proportion of the sexes, and the latter produce nothing but large females.† In other words, the directly fecundated and more highly vitalized ova produce nothing but large females, while the parthenogenetic offspring is smaller and composed of both males and females.

The curious facts, as now understood, in the economy of the common hive-bee, seem at first to militate against the conclusion that food has no influence on the sex of larvæ, but in reality they do not, though they indicate that the sex may be altered or determined after partial or imperfect conception has already taken place. All eggs not directly impregnated produce drones or males (*not females*, as "*A.S.P.*," by a singular lapse of thought, has stated on p. 177 of the March number of the NATURALIST), while

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* See AMERICAN NATURALIST, vi, pp. 692, 747, and Missouri Entomological Reports, iv, p. 65 and v, p. 85.

† To give a single illustration: A large wool gall—the modification and deformation of a bud—is tolerably common on our black oaks. The flies produced from it (*Cynips q. operator*) are bisexual. Mr. Bassett has witnessed the female depositing in acorns of the same trees on which the wool galls occur. The product of these eggs is a pip-like gall (the *C. q. operatola* of my manuscript) which develops between the cupule and the fruit. It is quite irregular in form, but with the apical end tapering more or less to a point and the basal end rounded. It is greenish when young, yellowish when mature, and the larva rests in a cream-colored ovoid cell, easily freed from its pip-like covering. This gall is generally numerous enough to render the acorns abortive, and I have known it since 1869. In August, 1871, while visiting Mr. Bassett, I collected a number from *Quercus ilicifolia*, and brought them home in the hope of rearing the flies from them. This spring, after a lapse of about twenty months, and just as the oak buds were bursting I succeeded in obtaining a number of flies, every one of them females and agreeing with *C. q. operator* except in being larger. Singularly enough this very year Mr. Bassett succeeded for the first time in finding the producer of the woolly gall, *C. q. operator*, ovipositing in buds; and his description leaves no doubt that the flies he thus discovered are identical with my bred specimens.

aose which are impregnated at the will of the mother produce 'emales either partly or fully developed, *i.e.*, workers, or queens. The rule with animals is that the ova perish unless vitalized by the direct influence of the male spermatozoa. Nevertheless parthenogenesis in many of the lower forms of animal life, and especially in insects, is an admitted fact; and what does it imply? To my mind it implies that in exceptional cases, the male element is sufficiently potent to vitalize the ova in the second generation, or that it may endure until succeeding generations; that, in short, to use Owen's words, "the spermatic virtue of the ancestral coitus" may influence the descendants. Von Siebold does not accept this explanation, but there are many facts which indicate that it is the true one, and the male element becomes exhausted in time and is needed sooner or later for the continuance of the species.

Parthenogenesis has repeatedly occurred in species which normally cannot multiply without direct sexual intercourse, *e. g.*, in *Bombyx mori*, *Sphinx ligustri*, etc.; while in a great number of others the embryo, in eggs not directly fecundated, develops up to different stages. What in some species is the exception becomes the rule with others, of which the hive-bee is an example. The male element may be said to possess all degrees of potency in its influence on the reproductive function of its immediate issue, as the embryo in ova not directly fecundated attains all degrees of development before death. In cases of parthenogenesis it is potent enough, vital enough—to cause full development of the offspring for one or more generations, though, in the majority of instances, and especially where this mode of reproduction does not occur as a rule, this offspring is most frequently male. Finally, it may be so potent, as in what is termed thelotoky, that females instead of males are produced.

The ova in a virgin queen bee may, therefore, be said to be al ready partially fecundated — sufficiently so to produce males c drones; but they must be more thoroughly vitalized, by the dire male influence, before the female sex can be stamped upon the Even here, however, the sex is not changed after the depositior the eggs, and it is not the influence of food which produces change.

Though I believe that the evidence is against Mrs. Treat's clusion, I hope she will continue her experiments, with that

oughness and exactness of which she is capable. Nature's contrivances for the maintenance of life in all its wonderful and varied phases are inexhaustible, and we are ever laying down rules and theoretical laws, only to find them violated and upset, as we more truly interpret her ways. She is as watchful of the myriad invisible atoms that mantle o'er the pond with green, or of the unseen swarms that fill the air "though one transparent vacancy it seems," as she is of the higher forms of life. Plastic, she conforms in every conceivable aud inconceivable way to the wants of her immense family. She shows us

> "The ant's republic and the realm of bees;
> How those in common all their stores bestow,
> And anarchy without confusion know;
> And these forever, tho' a monarch reign,
> Their separate cells and properties maintain,"

and calls loudly on us to read aright and solve her yet many untold secrets.

THE FLORA OF THE DISMAL SWAMP.

BY PROF. J. W. CHICKERING, JR.

A few notes of a recent botanical trip to the Dismal Swamp, that romance of our geographies and Moore's ballad, giving its characteristic flora, with the species found in flower, may not be wanting in interest.

Sunrise, on the morning of April 11th, found our party of two, Mr. William H. Seaman of Washington, and myself, just ready to make the landing at Old Point Comfort. A stroll before breakfast, for a mile or two along the sandy point, brought us to small groves of pitch pine (*Pinus rigida*), interspersed with thickets of dwarf live oak (*Quercus virens* var. *maritima*), here reaching its northern limit, while inside the fortress the true live oak attains quite a large size. The prickly pear (*Opuntia vulgaris*), is scattered along the sand, and on one almost inaccessible edge of the rampart displays its reddish fruit. Along the ramparts occur the bright blue spikes of the grape hyacinth (*Muscari botryoides*), with *Lamium amplexicaule*, *Sisymbrium Thaliana* and *vicia*. A walk of a couple of miles to Hampton

reveals nothing of special interest, *Viola cucullata* and *primulæfolia* being the only species noticed. The suburbs of Norfolk abound with pride of China (*Melia azedarach*), still retaining its whitish drupes, three or four species of magnolia and other distinctively southern trees, while *Yucca gloriosa* flourishes most thriftily on heaps of garden rubbish.

The next morning a little steamer received us for our trip, up the Elizabeth River, through the Dismal Swamp Canal, and down the Pasquotank River, to Elizabeth City, N. C., forty miles in all.

The swamp region is of indefinite extent, being estimated at from six hundred to one thousand square miles, thirty miles or more from north to south, and twenty or more, from east to west. Much of it has been cleared and partly drained, here and there a clearing of several hundred acres meeting the eye, said to be capable of producing fifty bushels of shelled corn to the acre, while at rare intervals appear neat, white and inviting mansions.

It seems originally to have been heavily wooded. The cypress (*Taxodium distichum*), juniper (*Juniperus Virginiana*), tulip tree (*Liriodendron tulipifera*), and the sweet and sour gums (*Liquidambar Styraciflua* and *Nyssa uniflora* and *aquatica*), are abundant and attain a large size.

Most of the large trees, however, have been cut off, or have fallen victims to the frequent fires, several of which were raging during our visit, and lighted up the horizon at night; often by these fires, the peaty soil for miles is burned to the depth of four or five feet; the hollow thus formed soon fills with water, and ever after retains a truly "dismal" appearance. But, for the most part, the swamp exhibits almost tropical luxuriance, the true canebrake almost forbidding passage. The foliage at this season is largely evergreen, the maples being only partially in leaf and the cypress but beginning to put forth its delicate leaflets. *Ilex glabra*, inkberry, or, as it is called there, gall-berry, is the most abundant shrub, especially along the watercourses, occurring, from two to ten feet in height, its black berries contrasting finely with its glossy leaves. The sweet bay (*Magnolia glauca*), the holly (*Ilex opaca*), often with its scarlet berries, the great laurel (*Rhododendron maximum*), and perhaps loblolly bay (*Gordonia Lasianthus*), are very abundant; while climbing high over all is the *Smilax laurifolia*, with its large, stout, evergreen leaves, appearing as if pinnately compound, and lower down the green-brier (*S.*

rotundifolia), weaving almost impassable barriers with its tough prickly stems, also *Myrica Gale*, and *Leucothöe Catesbæi*. But most beautiful of all, at this season, is the yellow jessamine (*Gelsemium sempervirens*), twining around trees to the height of twenty or thirty feet, covering thickets, hanging in festoons from the branches, and throwing out everywhere its racemes of golden yellow blossoms, loading the air with its fragrance. It has but one drawback, the frequent tendency of its perfume, in a close room, to cause headache and other disagreeable symptoms.

Of deciduous trees and shrubs, just opening, we noticed *Acer rubrum* and *dasycarpum*, horse-sugar, *Symplocos tinctoria*, a beautiful shrub, worthy of cultivation, *Pyrus arbutifolia*, *Quercus salicifolia*, and very abundantly *Rubus villosus*, with two or three species of *Vaccinium* and *Gaylussacia*. Along the canal banks, and at times, in large masses, forming almost impenetrable canebrakes, from two to twenty feet in height, we found *Arundinaria gigantea* and *tecta*, being fortunate enough to detect the former in flower, on the shorter stems. This is a most troublesome weed in the clearings, its matted roots resisting everything but fire or a breaking-up plough.

Leaving the steamer and paddling three miles up a smaller canal to Lake Drummond, we met with *Osmunda regalis*, *Claytoniana* and *cinnamonea*, in great abundance and luxuriance; also *Typha latifolia*, *Nesæa verticillata*, great quantities of *Saururus cernuus*, *Onoclea sensibilis*, *Mitchella repens*, *Viola primulæfolia* and *Orontium aquaticum*, only the last two being in flower. The lake is about six miles long by four wide, and is so bordered by cypress swamp, that except in a boat no access to it can be had. The water is as dark as brandy, but not unpalatable nor unhealthy. Fish are quite plenty. We saw no animals, though foxes, "possum" and "coon" are plenty, and bears and deer are seen occasionally. Birds too are scarce; now and then a turkey buzzard sails slowly overhead, or a hawk starts up from an old stump, or a flock of crows wind their noisy way from wood to cornfield, but very few of the sparrows or flycatchers or other cheerful occupants of ordinary woods meet the view. For the most part silence and solitude reign supreme.

Around Elizabeth City, the ground is dry and the soil good, and we found in addition to species already enumerated *Senecio tomentosus*, *Asarum arifolium*, *Ranunculus pusillus* and *bulbosus*,

Anemone nemorosa, *Arabis lævigata*, *Barbarea vulgaris*, *Callitriche verna*, *Proserpinaca palustris* and *pectinacea*, *Hydrocotyle umbellata*, and *Sagittaria*. On the trunks of the fine elms along the streets is found, very abundantly, *Polypodium incanum*, its root-stocks creeping over the bark, and covering them with its delicate fronds to a height of twenty feet. Though apparently dry and dead, upon being brought home and placed in a fernery, the fronds began to expand and some new ones were seen putting forth. A later trip would doubtless reveal many more species, but with the drawback of possible chills and certain yellow flies and mosquitoes.

INJURIOUS AND BENEFICIAL INSECTS.

BY A. S. PACKARD, JR.*

THOUGH the reporter was absent during most of the past season, and was unable, except in a slight degree, to make any special investigations on the habits of our more injurious insects, yet with the help of others some new material is here offered that may be serviceable to farmers and gardeners. The facts that we have to present may often seem disconnected and desultory, but few except experts in natural history are perhaps aware how difficult and prolonged a task it is to follow out the transformations of any particular insect, and study thoroughly its habits in its different stages of growth. Unlike birds, quadrupeds and fishes, which have similar habits at all stages of growth, an insect, with its three separate stages of larva, pupa and adult, leads as it were three lives, with different surroundings, and in each of those stages may be regarded as a different animal. Then it is often extremely difficult to ascertain to what beetle or moth or bee such or such a grub or caterpillar belongs. Our entomologists are not numerous enough, and often from their time being taken up with the pursuits of their profession, usually not that of science, are unable to spend the time in the field to observe the

* Third Annual Report on the Injurious and Beneficial Insects of Massachusetts, being a reprint, with corrections, from the 20th Annual Report of the Secretary of the Massachusetts Board of Agriculture, 1873.

habits of insects for themselves. Unfortunately, also, so backward is the science of entomology in this country, that the attention of its students is at present fully engrossed with classifying and describing the adult insects. When it is to be borne in mind that there are within the limits of the United States, probably at a low estimate, ten thousand species of *Hymenoptera* (bees, wasps, ichneumon flies, saw-flies, etc.), half as many butterflies and moths, about ten thousand species of flies, as many of beetles (*Coleoptera*) and of bugs (*Hemiptera*), and several thousand species of grasshoppers, etc. (*Orthoptera*), and neuropterous insects, such as dragon-flies, caddis-flies, etc., etc., the whole amounting to upwards of fifty thousand species of insects, to say nothing of the spiders, mites and ticks, centipedes and millepedes, it is evident that in the mere preliminary work of identifying and properly describing these myriad forms—an intellectual work requiring as much good sense, discretion and knowledge as shown in the pursuit of medicine, the law or education,—that all this work, which is simply preliminary in its nature, is a vast one, and that the combined exertions of many minds over several generations will not exhaust the subject. As it is, there are in this country only about thirty entomologists who publish anything relating to insects. Necessary as it is, this work of classification is by no means the highest and most useful branch of physical science. He who studies carefully the habits and structure of one insect, and, if injurious to agriculture, lays before the farmer and gardener a true story of its mode of life, is a true benefactor to agriculture, and at the same time benefits science more than he who describes hundreds of new species. Such an one was Dr. Thaddeus W. Harris, whose leisure moments were consecrated to the benefit and advancement of the agricultural interests of our state, and the commonwealth perhaps never made a better investment than in supplying the agricultural community with an illustrated edition of his immortal work. On looking over Dr. Harris's work we find that he mentions about six hundred species as injurious to vegetation, and as others have been added since then, it is not improbable that we have at least one thousand destructive species, *i. e.*, about one-tenth of the entire number (10,000) of insects which undoubtedly are to be found living within the limits of this state. As to the losses sustained from their attacks it would be difficult to say how great they are, but it

is to be estimated at least by hundreds of thousands of dollars. The amount of waste by the agency of insects is really appalling, and even now but slightly appreciated by our farming community.

We have perhaps little idea how many insects are preying upon our crops, our shade and ornamental trees. There are, probably within the limits of our country, one-tenth of the number, *i. e.* five thousand, which are either at present engaged in the work of injury, or are destined to be, with the growth of civilization, which means in this instance the destruction of the natural food of these insects and the substitution of a different diet, our choicest grains and fruits, in their stead.

During the last summer the canker-worm was as destructive as ever, and it seems to have gained a firm foothold among us. It is scarcely creditable that so conspicuous and comparatively easily assailed an insect as this does so much annual damage. It would seem as if the birds did not feed upon it to much extent. We have personally never seen birds feeding upon the canker-worm, though Professor Wyman states that doves eat them sometimes in large numbers and it is thought that the crow blackbirds pick up the caterpillars. As we have stated in a former report there are certain kinds of caterpillars that birds do not relish. Indeed birds seem to have certain fancies of their own among edible insects. Thus the martin will store up in its nest quarts of the common striped beetle of the potato, to the exclusion of other insects.

The reporter would be greatly obliged for any facts upon this subject communicated by those who may have a chance to observe what birds feed on particular kinds of insects and at what season and month of the year.

Our cranberry crop has been grievously ravaged during the year past, though the writer has no information to give at present in relation to this subject farther than that recorded in the article entitled "New and Little Known Insects," in the "Report on Agriculture of the State for 1870," and that given in the author's "Guide to the Study of Insects," though he has visited several cranberry pastures during the recent autumn. In conclusion, before offering the accompanying remarks on certain injurious and beneficial insects, the reporter would invite the attention of agriculturists to those insects that prey on the cranberry crop and other injurious insects, and beg them to communicate to him at

Salem, specimens and information about their habits and extent of ravages which may be of use in making up the next year's report.

INSECTS INJURIOUS TO THE STRAWBERRY.

The May Beetle.—With the increasing attention paid to the culture of the strawberry, it has been found that several insects not before suspected to be inclined to feed on this plant, now habitually frequent it. Of these perhaps the most injurious is the strawberry saw-fly, which in this state, but more especially the western states, as in Illinois, does in some cases the most grievous damage. Then a few moths which have been known to feed on fruit-trees, the currant, etc., have transferred their affections to the strawberry; such are the apple-leaf-roller or *Tortrix*, the saffron measuring-moth (*Angerona crocataria*), and several other caterpillars found in the western states, and described in the entomological reports of Messrs. Walsh and Riley, and also in "Harris's Treatise on the Injurious Insects" of this state, and the reporter's "Guide to the Study of Insects."

Next however in importance to the strawberry saw-fly (*Emphytus maculatus*), is one of the most common and familar of all these insects which everywhere force their attention upon us. This is the common May beetle, June beetle or "dor bug," the American representative in its abundance and injurious qualities of the European cockchafer.

Dr. Harris has given a brief sketch of its habits and transformations in his "Treatise," and referred to the injury the grub, sometimes called "white-worm," does to the roots of grass, remarking that "in many places the turf may be turned up like a carpet in consequence of the destruction of the roots." He however does not say that it attacks the strawberry-roots, which it has for several years been known to do in gardens about Salem. My attention was especially called to its ravages by Mr. D. M. Balch, of Salem, who has lost many strawberry-plants by the white grub. It seemed evident that they were introduced in the manure placed around the roots, as during July and late in summer, a manure-heap near by swarmed with the well-known white grubs, in various stages of development, some apparently in the second year and others in the third year's growth. They eat the main roots of the plant, thus destroying one plant after an-

other. From this it will be obvious that if we observe the plant to wilt and suddenly die, we may look for the white grub and at once kill it to prevent farther ravages. It is evident, so large and voracious are these worms, that one plant would be a mere trifle to one of them.

It also eats down in much the same manner young squash-plants, as I am told by Mr. C. A. Putnam, of Salem, who has been obliged to plant the seed over once or twice. They attack young plants at the time when they have thrown out three or four leaves. It is obvious that in dealing with this destructive insect we must become familiar with its habits. Every one knows the larva or grub of this insect, so that a detailed description is not necessary. It is a large, soft-bodied, thick, white worm, nearly as large as the thumb. Its head is yellowish or pale horn-colored. Its skin is so thin and transparent that the air-vessels and viscera can be seen through it, while, though it has three pairs of legs, it is so gross and unwieldy that it lies, when dug out of its retreat, flat upon its side.

How many years the grub lives before changing into the beetle we do not know, but probably at least three. It arrives at maturity in the autumn, and early in May in this state the chrysalis may be found in little rude cells or chambers about six inches under the mould, in which position we have found it in Maine late in May. During the latter part of May and early in June, *i. e.* for about a month, it flies about at night, especially on warm nights. By day it hides in fruit and other trees, clinging to the underside of the leaves by its long, curved claws, which are admirably adapted for the purpose. Here it does at times much injury, especially, as Harris remarks, to cherry-trees.

Where it lays its eggs is not definitely known, but it is probable that it burrows in the soil and there lays its eggs, as does the European cockchafer, of whose habits Harris gives a summary, and also the goldsmith beetle, of which we give an account far ther on. Riley however says that "soon after pairing, the femal beetle creeps into the earth, especially wherever the soil is loos and rough, and after depositing her eggs to the number of fort or fifty, dies. These hatch in the course of a month, and, t' grubs growing slowly, do not attain full size till the early spri of the third year, when they construct an ovoid chamber, lir

with a gelatinous fluid; change into pupæ, and soon afterwards into beetles."

In the autumn at the approach of cold it descends to a considerable depth below the surface to avoid the frost, probably about two feet below the usual depth at which the ground is frozen in the winter. At the approach of warm weather, however, it makes its way up near the surface, where it forms a slight cell by wriggling about, and then passes into the pupa state. It is said to sometimes pupate and appear in the winged state in the autumn.

As to remedies against this grub, the careful gardener will in the first place destroy all those that he sees by crushing them to death. When the manure is spread over the strawberry bed he must watch it narrowly for the grubs so easily seen, and kill them. When a vine is seen to die down suddenly in summer he must then dig around the roots and search for them, and go over the bed carefully, even if help has to be employed. It is better to spend even much time and money for two or three years in succession, in endeavoring to exterminate these grubs, than to yield passively to the scourge. The remarks of Mr. Lockwood that we reprint in our account of the goldsmith beetle are eminently practical as applied to this insect. As for special remedies, we have none to propose. Watchfulness and care in culture are better than any special nostrums.

Undoubtedly the natural enemies of this grub are many, but we have no observations bearing on this point. A fungus attacks the grubs in certain seasons, often in considerable numbers. We have received specimens from Missouri of dead and dried grubs, with a long stem growing out from them, the result of the attacks of this fungus. It has been figured by Mr. Riley, who states that another fungus attacks this worm in Virginia. It is well known that caterpillars and even the common house-fly are sometimes attacked by a fungus which replaces the animal portion with its own vegetable substance.

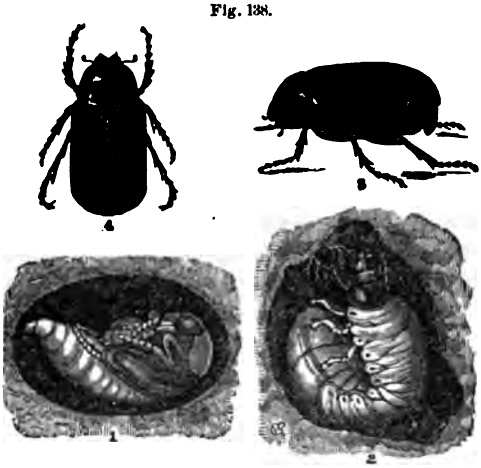
While many animals, such as skunks, moles, crows, etc., prey on the beetles, the only insect enemy I have personally observed is the fierce carnivorous Calosoma beetle (*C. calidum*) which I have noticed on a blueberry bush busily engaged in tearing open the hard, horny sides of one of these beetles, which was in vain

struggling to escape; on taking up the May beetle a large hole had been eaten into its side disclosing the viscera.

Occasionally the beetles appear in immense numbers. It is then the duty of the agriculturist to pick them off the trees and burn them. If the French take the pains to practise hand-picking, as in one instance "about eighty millions were collected and destroyed in a single portion of the lower Seine" (Riley), our gardeners can afford to take similar pains.

A description of the May beetle is scarcely necessary. The admirable figure, taken from Harris' work (fig. 138), gives a good idea of its appearance and size. It is bay colored, or chestnut and brown, with yellowish hairs beneath, and is nearly an inch in length. Its scientific name is *Lachnosterna fusca*, or, literally translated, the brown woolly-breasted beetle. The pupa is white.

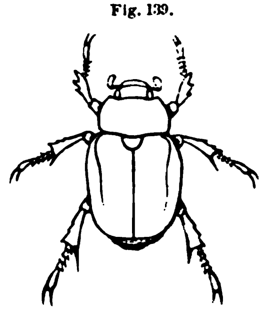
Fig. 138.



May Beetle and young.

The Goldsmith Beetle.—We also have in this state an insect allied to the preceding, and with much the same habits, both in the adult and preparatory states. It is the *Cotalpa lanigera* (fig. 139). It is nearly an inch in length, bright yellow above, with a golden metallic lustre on the head and thorax, while the under side of the body is copper-colored, and densely covered with white hairs.

Fig. 139.



Goldsmith Beetle.

Dr. Harris says that it is very common in this state, remarking that it begins to appear in Massachusetts about the middle of May, and continues generally till the twentieth of June. "In the morning and evening twilight

they come forth from their retreats, and fly about with a humming and rustling sound among the branches of trees, the tender leaves of which they devour. Pear trees are particularly subject to their attacks, but the elm, hickory, poplar, oak, and probably also other kinds of trees, are frequented and injured by them." Dr. Lockwood has found it on the white poplar of Europe, the sweet-gum, and has seen it eating the Lawton blackberry. He adds that the larvæ of these insects are not known; probably they live in the ground upon the roots of plants.

It has remained for the Rev. Dr. S. Lockwood to discover that the grub or larva of this pretty beetle in New Jersey devastates strawberry beds, the larva feeding upon the roots, in the same manner as the May beetle. His account was first published in the AMERICAN NATURALIST (vol. ii, pp. 186, 441). He says that in the month of May in the ordinary culture of his garden the spade has turned up this beetle generally in company with the May beetle. He found that some of the beetles, as in the case of the May beetle, assume the adult beetle state in October and remain underground for seven months before appearing in the spring.

Larva. The larvæ (fig. 140) he describes as "whitish grubs, about one inch and three-quarters long and over half an inch thick, with a yellowish-brown scale on the part corresponding to the thorax." I may add that it so nearly resembles the young of the May beetle that it requires a close examination to tell them apart. The proportions of the two are much the same; if anything the *Cotalpa* is slightly shorter and thicker, and its body is covered with short, stiff hair, especially at the end, while in the May beetle the hairs are much finer, sparse, and the skin is consequently shiny. They also differ in the head, being fuller, more rounded in *Cotalpa*, the clypeus shorter and very convex, while in the May beetle it is flattened. The upper lip (labrum) is in *Cotalpa* longer, more rounded in front and narrower at the base, and full convex on the surface, while in the young May beetle it is flat. The antennæ are longer and larger in the goldsmith beetle, the second joint a little over half as long as the third, while in the May beetle grub it is nearly three-quarters as long; the third joint is much longer than in the latter grub, while the fourth and fifth are of the same relative length as in the May beetle, but much thicker. The jaws (mandibles) are much alike in both, but not quite so acute in the *Cotalpa* as in the other, nor are the inner teeth so prominent. The maxilla is much longer and with stouter spines, and the palpi are longer and slenderer in the grub of *Cotalpa* than in the other, though the joints have the same relative proportion in each; the basal joint is nearly twice as long as in the May beetle. The under lip (labium) is throughout much longer, and the palpi, though two-jointed in each, are much longer and slenderer in the grub of *Cotalpa* than in that of the May beetle. The feet are much larger and more hairy in the *Cotalpa*. Both larvæ are about an inch and a half long, and a third ('35) of an inch thick at the widest part.

Fig. 140.

Larva of the Goldsmith Beetle.

As regards the number of years in the life of this insect, Dr.

Lockwood remarks that "when collecting the larvæ in May, I often observed in the same places grubs of the *Cotalpa* of at least four distinct ages, each representing a year in the life of the insect, judging from Renny's figures of the larvæ of the English cockchafer, or dor beetle (*Melolontha vulgaris*). But the cockchafer becomes an imago in January or February, and comes forth into active life in May, just four years from the deposit of the egg. Supposing our *Cotalpa* to take on the imago form in autumn, and to spend its life from that time to the next May in the ground, it would be five years old when it makes its début as an arboreal insect." It is possible that Dr. Lockwood may be in error regarding the age of this beetle, as M. T. Reiset says in France this insect is three years in arriving at its perfect beetle state. The following remarks on the habits of the European chafer may aid observers in this country in studying the habits of our native species. M. Reiset says (see "Cosmos" as translated in the AMERICAN NATURALIST," vol. ii, p. 209) "that this beetle in the spring of 1865 defoliated the oaks and other trees, while immense numbers of their larvæ in the succeeding year, 1866, devoured to a fearful extent the roots of garden vegetables, etc., at a loss to the department of the lower Seine of over five millions of dollars. This insect is three years in arriving at its perfect beetle state. The larvæ, hatched from eggs laid by the beetles which appeared in such numbers in 1865, passed a second winter, that of 1867, at a mean depth in the soil of forty one-hundredths of a metre, or nearly a foot and a half. The thermometer placed in the ground (which was covered with snow) at this mean depth, never rose to thirty-two degrees F. as *minimum*. Thus the larvæ survived after being perfectly frozen (probably most subterranean larvæ are thus frozen, and thaw out in the spring at the approach of warm weather). In June, 1867, the grubs having become full fed, made their way upwards to a mean distance of about thirteen inches below the surface, where, in less than two months, they all changed to the pupa state, and in October and November the perfect beetle appeared. The beetles, however, hibernate, remaining below the surface for a period of five or six months and appearing in April and May. The immature larvæ, warned by the approaching cold, began to migrate deep down in the soil in October, when the temperature of the earth was ten degrees above zero. As soon as the snow melted they gradually rose towards the surface."

As regards the time and mode of laying the eggs, we quote from Dr. Lockwood as follows: "On the evening of the 13th June last we caught in the drug-store, Keyport, whither they were attracted by the profusion of light, four *Cotalpas*, representing both sexes. These were taken home and well cared for. On the 16th a pair coupled. A jar of earth was at once provided, and the beetles placed on top of the dirt. In the evening the female burrowed and disappeared. Near midnight she had not returned to the surface; next morning she had reappeared. The earth was then very carefully taken from the jar, and, as removed, was inspected with a glass of wide field but low power. Fourteen eggs were found, not laid (as we expected) in one spot or group, but singly and at different depths. I was surprised at their great size. Laid lengthwise, end touching end, two eggs measured very nearly three-sixteenths of an inch. They were like white wax, semi-translucent; in form, long-ovoid and perfectly symmetrical. On the 13th of July one had hatched; the grub was well formed and very lively. Its dimensions were about five-sixteenths of an inch in length and about three-thirtieths of an inch in thickness. It was a dull white, the head-plate precisely that dull yellow seen in the adult grub, the legs the same color, and the extremity of the abdomen lead-color, the skin being transparent. For food, a sod of white clover (*Trifolium repens*) was given them, roots downward, knowing that the young larvæ would come upward to eat. They were then left undisturbed until August 19th, when the sod was removed, and it was found that the grubs had eaten into it, thus making little oval chambers, which were enlarged as the eating went on. They were carefully picked out and a fresh sod of grass and clover supplied. They had now grown five-eighths of an inch in length, preserving the same colors.

It is quite possible that a few of the eggs escaped me in the search. I am of opinion, however, that from fifteen to twenty is the average number laid by one beetle. In short, the insect lays her eggs in the night, probably not more than twenty. The hatching of these required in the present instance twenty-seven days. It must be remembered that a large portion of this time was remarkably cold and wet. It is almost certain that with favorable thermal conditions this might be lessened fully seven days.'

Regarding its ravages in strawberry beds, I cannot do better than quote from Dr. Lockwood's excellent account in the AMERICAN NATURALIST: "When on a visit in September last to the farm of a celebrated strawberry grower in Monmouth county, N. J., my attention was directed to certain large patches badly thinned out by, as the phrase went, 'the worm.' The plants were dead on the surface and easily pulled up, the roots being eaten off below. It was observable that the fields which presented the worst appearance were all of the same kind of plant,—that known as Wilson's Albany Seedling. Besides this there were nine other varieties under culture,—Barnes' Mammoth, Schenck's Excelsior, the Agriculturist, Triomphe de Gand, Cutter's Seedling, the Jucunda, Pine-apple, Early Scarlet and Brooklyn Scarlet. While the Wilson stood second to none of these as a prolific fruit-bearer, yet it fell behind them in vigorous plant-growth. Hence, while every kind was more or less affected, the other varieties seemed saved by their own growth and energy from a destruction so thorough as was that of the Wilson. These patches were all planted in the spring, and all received the same treatment, the ground being kept open and free from weeds. The amount of the spring-planting was seven and a half acres. Of the Wilsons there were three different patches in places quite separated from each other, and on not less than five different kinds of soil. These patches were among and contiguous to those of the other varieties. While all suffered more or less, the chief injury befell the Wilsons, of which not less than two acres were irretrievably ruined. An examination turned up the depredator, who was none other than the larva of the goldsmith beetle, now engaged in the first one of its allotted three-summer campaigns of mischief. These grubs were from the eggs deposited in June in the well-tilled and clean soil, which, I have said elsewhere, I thought the *Cotalpa* preferred to meadow or grass lands. Compared with others, the larva of this beetle is sluggish and easily captured. The black grub of the spring, which is such a pest, attacking almost indiscriminately the early tender plants, inflicts its injuries chiefly in the night, the exception being that of dull and cloudy days. The night's mischief done, it descends into concealment at early dawn. Knowing this, the wise farmer is in search of it at an early hour, ere the warmth of the sun gives it warning to retreat. But the goldsmith grub can be taken at any hour of the day simply by scratching away

the earth from around the roots of those plants whose dark, shrivelled leaves tell of the enemy's presence. It is my belief that this devastation might have been spared by an outlay of from $20 to $30 for labor, much of which, under proper direction, could have been done by children. Therein would have been saved a strawberry crop for the ensuing summer, worth scarcely less than $2,500, for from this same farm the crop of a single acre has been sold for $1,500. Then, however valuable such labors are in the immediate results, that is but a fraction of their worth as respects the future. These *Cotalpa* grubs, with all their mischief, had not more than a third of their ultimate size; hence their real ravenousness is yet to come. Besides, what a prospect of increase of numbers, should even a moderate share of them reach maturity! Why should not our farmers seek to know something about their insect-enemies, and when practicable put forth some energy to meet such?"

Snails Injurious to the Strawberry.—Under this caption Prof. E. T. Cox publishes in the AMERICAN NATURALIST (vol. ii, p. 666) a note regarding the injury done in Indiana by a little snail (*Pupila fallax*), at present found occasionally though not abundantly in this state. Though this report refers chiefly to insects, yet in the future, as civilization advances and the country becomes more thickly settled, gardeners are undoubtedly destined to be plagued by these little animals, and a slight notice of them may not be out of place, as the ravages they commit may be sometimes wrongly attributed to insects.

It seems that Mr. and Mrs. Chappelsmith of New Harmony, Indiana, "found their strawberry plants dying rapidly, and on seeking for the cause discovered these mollusks at work upon the stems and crowns of the plants, rasping off the outer coating, and sucking their juices in such a manner as to cause them to decay. Mr. C. found as many as forty upon one plant, and thinks they have killed several thousand upon the different beds. Though more abundant on the strawberry, he has found them on a variety of plants. Since attention has been called to the depredations of these minute mollusks, they have been found at work upon the strawberry plants in all the gardens examined."

Though this species is not common with us, yet we have other kinds which are more or less so, and which may ultimately prove to be obnoxious. Yet it is not probable that snails will ever be

so abundant with us as in Europe, as our climate is much drier and hotter, snails needing a damp, rainy climate in order to flourish vigorously.

INSECTS INJURING THE BEAN.

The Bean-weevil.—In our article entitled "Injurious Insects New or Little Known," published in the Report of the Board of Agriculture for 1870, we described and figured the bean-weevil, which was then regarded as an imported species, the European *Bruchus granarius*, and some account was given of its habits. Afterwards in a short note published in our First Annual Report (p. 22), we stated that it was not an importation, but a native species which for some years has been known to be injuring the bean in New York and the Middle States. It was mentioned under the unpublished or manuscript name of *Bruchus varicornis* (Leconte). The same year Mr. Riley described it in his report on the injurious insects of Missouri under the name of *Bruchus fabæ*, and states that it appeared about ten years ago (1862) in Rhode Island, according to Mr. F. G. Sanborn, and is now known to appear in Illinois and Missouri.

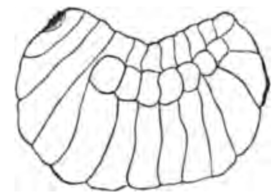
How extremely injurious this weevil has been, and still threatens to be, appears from both Mr. Riley's and my reports. We are sorry to add that this winter it is said to be very abundant in seed-stores in Boston, and unless checked in its course, a comparatively easy thing to do at this time, it will rapidly spread all over the state, and do incalculable injury to the bean crop.

I am indebted to Mr. C. A. Putnam, of Salem, for numerous living specimens of this weevil, with the beans from which they were emerging, obtained by him at a seed-store in Boston in February. We have figured, in our report for 1870, the bean perforated by the grubs. It is easy to tell by the little round dark spot on the outside of the bean, *i. e.*, the thin covering over the hole in which the weevil lies, whether the weevil lies within. Now is the time to plunge all the beans in hot boiling water to kill the weevils — treating them just as gardeners have been accustomed to deal with the well-known pea-weevil. Such beans as are found to be affected should at once be burned. Again, as suggested by Dr. Harris, in dealing with the pea-weevil, "if the peas are kept till they are a year old, the insects will leave them." So that by keeping the seed for two years in tin boxes, or other dry situa-

tions, where the weevil may come out and die, without being allowed to go at liberty, the beans may be sown with impunity. By the exercise of a little care, and by combination among gardeners this pest may be kept under.

Larva. The grub or larva occurred February 10th in different stages of growth, the largest being one-seventh (·14) of an inch long and about half as thick (·08). Other grubs were only half as long. Some chrysalides occurred also at this date while the adult beetles were coming out of the beans. The larva is a very thick, white, fleshy grub (fig. 141) with the body much curved and the head very minute and sunken in the body. The rings are much flattened, the sutures obscurely marked, and the rings are each divided by a transverse line separating it into two portions. There is a distinct, flattened, lateral ridge. The end of the body is much rounded and incurved. The head is white, becoming honey-yellow about the short, stout jaws.

Fig. 141.



Grub of Bean-weevil.

One specimen was in the semi-pupa state, being intermediate between the larva and pupa. Its body was straightened out, the head being at the extreme end and now quite prominent, while before it was hidden in the soft body. The three succeeding segments were full and swollen, the third being very distinct from the succeeding one, the basal abdominal segment. The whole body was much flatter and thinner than in the grub. It was evident that the remarkable changes by which it becomes transformed into the chrysalis state had begun.

INSECTS INJURIOUS TO FRUIT AND FOREST TREES.

The Seventeen-year Locust.—This remarkable insect having, after its long absence of seventeen years, again, as had been predicted by observers, made its appearance in the southerly parts of the state, we take this occasion to draw attention to its strange and unwonted habits, and to solicit aid from observers in the state in determining its natural boundaries. I should be greatly obliged if any persons in every town in the state in which it appeared would let me know of the fact, that we may ascertain its range. While it has been known to appear in the southeastern part of the state, and even as far east as Plymouth, situated on Massachusetts Bay, we want to know in what towns to the north of this it has appeared. The point is of much interest to naturalists, as in determining the northern boundary of the district it inhabits, which undoubtedly accords with certain lines of temperature which regulate the distribution of many other insects and plants, it may throw much light on the physical geography and meteorology of our state. The cicada also often does much injury to fruit-trees, especially in the West, and it is thus, aside from its deeply interesting and unique mode of life, an object of solicitude to farmers.

The most remarkable fact about this creature is that, while so far as we know, the other species of cicada pass but a year in attaining the winged state, the present one lives underground over sixteen, assuming at the end of seventeen years the perfect winged state. We have seen that the May beetle is about three years in obtaining the beetle state, and the wire-worms and boring-beetle, such as the apple-borer, may be four or five years in the larval condition, but no other insects are as yet known, with this sole remarkable exception, to be so long-lived in their immature state.

The remarks that we have to make are simply supplementary to what the reader may find in Dr. Harris' admirable account in his "Treatise." He brings out the important fact that these insects are said, in the larval state, to do much injury to apple and pear trees by drawing the sap from the roots, so that the tree may decline in health for years without any apparent cause. This needs to be substantiated by farther observation. As regards the kinds of this I may quote from a communication from William Kite in the AMERICAN NATURALIST, vol. ii, p. 442, as confirming and adding somewhat to Dr. Harris' statements: "Seeing in the July number of the NATURALIST a request for twigs of *oak* which had been stung by the so-called seventeen-year locust, I take the liberty of sending you twigs from *eleven* different varieties of trees in which the females have deposited their eggs. I do this to show that the insect seems indifferent to the *kind* of wood made use of as a depository of her eggs. These were gathered July 1st, in about an hour's time, on the south hills of the 'Great Chester Valley,' Chester county, Pa. No doubt the number of trees and bushes might be much increased. The female, in depositing her eggs, seems to prefer well-matured wood, rejecting the growing branch of this year, and using the last year's wood and frequently that of the year before, as some of the twigs enclosed will show. An orchard which I visited was so badly 'stung' that the apple trees will be seriously injured, and the peach trees will hardly survive their treatment. Instinct did not seem to caution the animal against using improper depositories, as I found many cherry trees had been used by them, the gum exuding from the wounds, in that case sealing the eggs in beyond escape.

"The males have begun to die, and are found in numbers under the trees; the females are yet busy with their peculiar office. The length of wood perforated on each branch varied from one to two

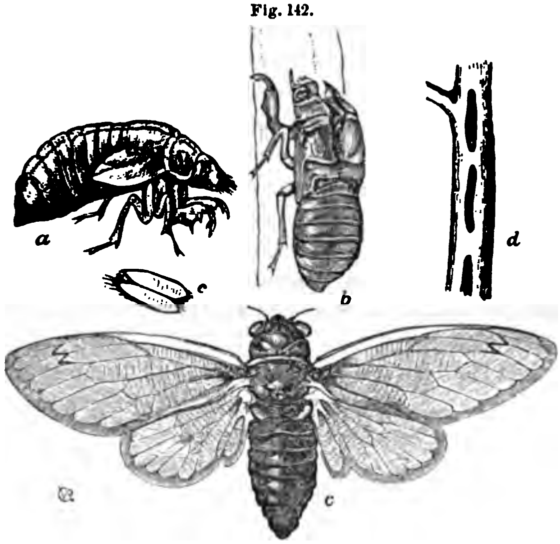
and a half feet averaging probably eighteen inches; these seemed to be the work of one insect on each twig, showing a wonderful fecundity.

"The recurrence of three 'locust-years' is well remembered in this locality—1834, 1857 and 1868. There has been no variation from the usual time, establishing the regularity of their periodical appearance."

As regards the time and mode of hatching, Mr. S. S. Rathvon of Lancaster, Pa., contributes to the same journal some new and valuable facts, which we quote: "With reference to the eggs and young of the seventeen-year cicada, your correspondent from Haverford College, Philadelphia, is not the only one who has failed to produce the young by keeping branches containing eggs in their studios. I so failed in 1834 and 1851, and indeed I have never heard that any one has succeeded in that way, who has kept them for any great length of time. In the brood of 1868, the first cicadas appeared here in a body, on the evening of the second day of June. The first pair *incoitu*, I observed on the 21st, and the first female depositing on the 26th of the same month. The first young were excluded on the 5th of August. All these dates are some ten days later than corresponding observations made by myself and others in former years. On the 15th of July I cut off some apple, pear and chestnut twigs containing eggs, and stuck the ends into a bottle containing water, and set it in a broad, shallow dish also filled with water, the whole remaining out of doors exposed to the weather, whatever it might be. The young continued to drop out on the water in the dish for a full week, after the date above mentioned. I could breed no cicadas from branches that were dead and on which the leaves were withered, nor from those that from any cause had fallen to the ground, and this was also the case with Mr. Vincent Bernard, of Kennet Square, Chester county, Pa. After the precise time was known, fresh branches were obtained, and then the young cicadas were seen coming forth in great numbers, by half a dozen observers in this county. As the fruitful eggs were at least a third larger than they were when first deposited, I infer that they require the moisture contained in living wood to preserve their vitality. When the proper time arrives and the proper conditions are preserved, they are easily bred, and indeed I have seen them evolve on the palm of my hand. The eyes of the young cicadas are seen through the egg-skin before it is broken."

Mr. Riley, in an interesting account of this cicada in his "First Annual Report on Noxious, Beneficial, and other Insects of Missouri" for 1869, has shown that in the southern states thirteen-year broods of this insect are found. He remarks: "It was my good fortune to observe that besides the seventeen-year broods, the appearance of one of which was recorded as long ago as 1633, there are also thirteen-year broods, and that, though both sometimes occur in the same states, yet in general terms, the seventeen-year broods may be said to belong to the northern and the thirteen-year broods to the southern states, the dividing line being about latitude thirty-eight degrees, though in some places the seventeen-year brood extends below this line, while in Illinois the thirteen-year brood runs up considerably beyond it. It was also exceedingly gratifying to find, four months after I had published this fact, that the same discovery had been made years before by Dr. Smith, though it had never been given to the world."

Fig. 142.



The Seventeen-year Cicada and Pupa.

Mr. Riley predicts that in southern New England a brood will appear in 1877 and 1885. Probably the Plymouth brood which appeared in 1872, will not appear again for seventeen years, namely, in 1889, the two broods noticed by Riley appearing west of this town. As regards its appearance in Plymouth, in this state, Harris states that it appeared there in 1633. The next date given is 1804, " but, if the exact period of seventeen years had been observed, they should have returned in 1803."

Mr. B. M. Watson informs me from his personal observation,

that it also appeared in 1838, 1855 and 1872. In Sandwich it appeared in 1787, 1804 and 1821. In Fall River it appeared in 1834; in Hadley in 1818; in Bristol county in 1784, so that as remarked by Harris and others it appears at different years in places not far from each other. So that while in Plymouth and Sandwich we may look for its reappearance in 1889, in Fall River it will come in 1885, or four years earlier.

There are three species of cicada in this state, and in order that they may not be confounded in studying the times of appearance of the different broods of the seventeen-year species I add a short description of each form, so that they may be readily recognized in the winged and immature states.

Fig. 143.

Larva of Seventeen-year Cicada.

The two largest species are the seventeen-year locust (*Cicada septendecim*) and the dog-day cicada (*C. pruinosa*). Fig. 142, copied from Riley's report gives a good idea of this species: *a* represents the pupa; *b* the same after the adult has escaped through the rent in the back; *c* the winged fly; *d* the holes in which the eggs *e* are inserted. Fig. 143 represents the larva as soon as hatched. The adult may be known by its rather narrow head, the black body and bright red veins of the wings. The wings expand from two and a half to three and a quarter inches.

The pupa is long and narrow, and compared with that of *C. pruinosa* the head is longer and narrower, the antennæ considerably longer, the separate joints being longer than those of the dog-day locust. The anterior thighs (femora) are very large and swollen, smaller than in *C. pruinosa*, though not quite so thick, with the basal spine shorter than in that species, while the snag or supplementary tooth is larger and nearer the end; the next spine, the basal one of the series of five, is three times as large as the next one, while in *C. pruinosa* it is of the same size, or if anything smaller. The toe-joint (tarsus) projects over two-thirds of its length beyond the end of the shank (tibia), while in the other species it only projects half its length. The terminal segment of the body is rather larger than in *C. pruinosa*. The body is shining gum-color or honey-yellow, with the hinder edge of the abdominal segments thickened, but no darker than the rest of the body. Length one inch (·90–1), width about a third of an inch (·35) being rather smaller than that of *C. pruinosa* and much larger than that of *C. rimosa*.

The dog-day harvest-fly may at once be known by its large head, as wide as the body, and by the green markings on the head and thorax, especially the W-shaped mark on the latter. It expands three inches, and is a larger and more bulky insect than

the preceding. We know but little of its habits. Harris says that it invariably appears with the beginning of the dog-days, and in the vicinity of Boston he has heard it for many years in succession, with only one or two exceptions, on the 25th of July, for the first time in the season. According to Prof. A. E. Verrill, in our "Guide to the Study of Insects," it lays its eggs in the stems of the solidago or golden rod. "It made a longitudinal incision with ragged edges into the pith of the plant, then with its ovipositor forced its eggs a little distance down into the pith below the external opening: there were two rows of eggs succeeding the first single one, each pair diverging outwards, the lower ends of each pair nearly touching each other, and all placed very near together."

Fig. 144.

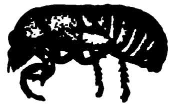
Pupa of Cicada pruinosa.

The pupa (fig. 144) is much the largest and thickest of the three species, being nearly twice as bulky as that of the two others. The head is very broad, short, triangular, much shorter than in the seventeen-year locust. There are no dark bands crossing the body. It is an inch in length and nearly one-half (·45) an inch wide.

One smaller species, the least cicada (*C. rimosa*), expands a little less than two and a half inches, and has a narrow head, with bright red markings on the head and thorax. For several years in Brunswick, Maine, I have noticed that it began its song on the 10th of June, and in this state it probably sings by the 1st of that month.

Its pupa (fig. 145) is in most respects intermediate between the first two species. The head is broadly triangular, like that of *C. pruinosa*. The antennæ have shorter and smaller basal joints, and not much larger than the second, while they are very unequal in size in the two other species; the third joint is much shorter than that of *C. septendecim*. The front of the head is much more hairy than in the others. The thorax is shaped much as in *C. pruinosa*, but the insect differs from both species in having a broad, dark brown conspicuous band on the hinder edge of each thoracic and abdominal ring.

Fig. 145.



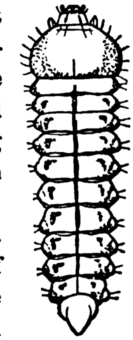
Pupa of Cicada rimosa.

The anterior femora are rather shorter than in the other species, but on the whole more like those of the seventeen-year cicada than the *C. pruinosa*. The spines are large and heavy; the basal one like that of *C. pruinosa*, but rather shorter and broader, with the tooth situated nearer the base. Of the five inner teeth the first one is twice as large as the second. Near the end of the tibiæ are two well-marked teeth, much more distinctly marked than in the other two species, which have but one low appressed tooth in their place. The tarsus projects about a third of its length beyond the tip of the tibia. Length ·80, breadth ·35 inch.

The Brachys Leaf-miner.—This and the following beetle have the singular habit of mining the leaves of plants. It is rarely that beetles live this sort of life, though many caterpillars and

maggots of flies are leaf-miners. Dr. Harris has given in his "Treatise" an account of the larva of Hispa which mines the leaf of the apple tree, eating the pulpy substance between the upper and under surface of the leaf. The two insects of which we now treat belong to the family of Buprestids, several species of which do much injury to our fruit and shade trees in the grub state. They are footless grubs and recognized by the broad, rounded, flattened segment just behind and partially enclosing the head. The young of the following insects depart somewhat from this typical form owing to their peculiar leaf-mining habits. The first of these is the young of the *Brachys æruginosa* which has been found by V. T. Chambers, Esq., of Covington, Ky., mining the leaves of the beech tree, and I am indebted to him for a specimen of the larva here figured (Fig. 146).

Fig. 146.



Larva of Brachys.

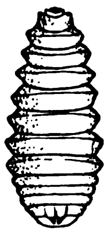
I may remark here that a closely allied beetle (*B. terminans*), I have often found resting in the leaves of the oak and beech. The beetles of this genus are flattened, angular ovate, and less than a quarter of an inch in length, and the scutellum is small, as Leconte observes, while the shanks (tibiæ) are linear. In the succeeding genus, Metonius, Leconte says that the body is triangular, while the scutellum is large, and the shanks are dilated.

Larva. The body of the larva is rather long, with the segments very deeply cut, being flattened, and produced laterally into a triangular projection, giving a serrate outline to the body, the teeth being obtusely rounded. The segment next behind the head is the widest, the succeeding segments gradually decreasing in width and increasing slightly in length to the end. The terminal segment is about half as wide as the body in its widest portion, and is somewhat triangular, with the sides parallel, and the tip obtusely pointed. The prothoracic segment or the one next the head is broader than long, and has a fleshy projection on each side at the base of the head. On the upper side of this segment is a large, square, slightly horny area. The head is anteriorly pale honey yellow, with two dark longitudinal parallel lines; the horny portion is about as long as broad, much flattened, subtriangular. The antennæ are very minute, slender, three-jointed, with the joints nearly equal in length. The jaws and palpi are so minute that a description will be of no practical use here. The body is finely shagreened, with a few fine scattered hairs. It is whitish, with a slight greenish tinge, and a quarter (·25) of an inch long, and less than a tenth (·07) of an inch broad. It was sent to me alive in September.

The Tick Trefoil Leaf-miner.—This insect (*Metonius lævigatus*) which is not uncommon in this state, has been found by Mr. V. T. Chambers of Covington, Ky., mining the leaves of the tick trefoil (*Desmodium*) during the early part of September. The larva is from ·15 to ·20 inch in length, and mines a broad, irregular patch,

sometimes only half the length of the leaf, but often it extends its burrow around the end of the midrib, half way down the other side of the leaf. The track of its burrow is irregularly sinuous. At the end of this gallery or burrow it forms a round chamber just as wide as the body is long, disk-shaped, the walls being convex, the cell looking like a smooth, regular blister.

Fig. 147.



Larva of Metonius.

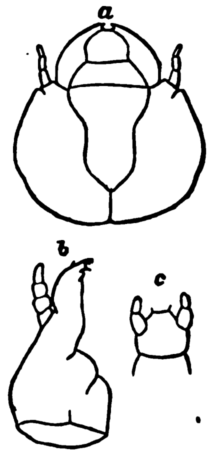
Larva. The grub (fig. 147) differs greatly in form from the preceding one, the body being quite thick, but little flattened, being rather convex above and below; in form oval lanceolate, widest in the middle, tapering much more rapidly posteriorly than toward the head. The segments, especially those of the abdomen, very convex on the sides, being produced triangularly into very acute teeth. The prothoracic ring is about the same width as the fifth abdominal ring, being narrower than the mesothoracic ring and having the sides somewhat sharply pointed, while those of the succeeding (metothoracic) segments are rounded. The eighth abdominal segment, or one next to the last, is transversely oblong, and about two-thirds as wide as the seventh. The ninth and last is a little over one-half as wide as the eighth. It gives rise to a minute projection at the end. The prothoracic segment and head are closely soldered together; the two together are transversely ovate elliptical, full convex on the front edge, the separation between the head and succeeding ring being indicated by a slight notch. The anterior surface of the head is somewhat flattened, with a small, squarish, pale, horny area. The horny portion of the front of the head is very minute compared with the similar part in the Brachys larva, and is scarcely perceptible except under high magnifying powers. The body is uniformly pale greenish, and the skin is smooth. The differences between the two larvæ are most remarkable, when we consider how closely the beetles resemble each other.

The Spotted-necked Languria.—This beetle is allied to Trogosita, an insect which is known to be injurious to housed grain, though the grub is still more intimately related to the European *Nemosoma elongatum*, which is found under the bark of elms in burrows inhabited by Hylesinus, a wood-boring beetle. Having received the Languria in all its stages of growth, from Mr. Belfrage of Texas, though the insect occurs in the middle states, it is thought that a description of it will not be out of place in a report on economic entomology, as some members of the group to which it belongs are known to be destructive. The adult beetle was first described by Say (under the name of *Languria puncticollis*) from Ohio. It is pale reddish, with the fore legs, wing-covers and end of the body black, with a large distinct black spot in the middle of the neck (prothorax). It is said by Mr. Say to frequent flowers.

The larva (fig. 148) is unusually long and slender, cylindrical, the body being of uniform thickness throughout, whitish, with smooth segments. The head is but little narrower than the rest of the body; the eighth ring of the abdomen is as large as the rest, while the ninth is much smaller, being rounded and bearing two dorsal, upcurved,

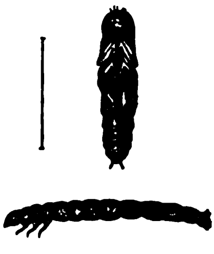
acute hooks. There are a few scattered hairs over the body. The six thoracic legs are well developed, and there is a stout, short, anal prop-leg. As usual there are nine breathing-holes (stigmata) on each side of the body. The head is somewhat flattened, squarish, the postclypeus (as we may call the triangular inclosure in the top of the head), shield-shaped with apex acute, and with two shallow pits (eyes?) on each side of the middle. The true clypeus is short, transverse. The feelers (antennæ) are inserted on the side of the head, and are as long as the clypeus is broad; they are four-jointed, with the third longest, the fourth very slender, not quite so long as the second. Upper lip (labrum) transversely oval, elliptic, the front edge curved, and the surface moderately convex. The jaws (mandibles) are stout, black at tips, three-toothed, the upper tooth small, the two lower ones equal. The maxillæ (*b*) have four-jointed palpi reaching to the end of the closed mandibles; the joints of nearly equal length; the third slender, but scarcely longer than the basal joint. The labium (lower or under lip, *c*) is small and situated on a long, narrow mentum; the palpi are two-jointed, the joints subequal, the second but a little longer than the first. Length of body, ·65; thickness, one-tenth of an inch (50 specimens). The pupa (fig. 149) is white, long and slender, with the club-shaped antennæ reaching to the middle of the anterior tarsi; the tarsi of the middle pair of legs reaching to the hinder edge of the first abdominal segment; hinder pair of legs concealed, with the exception of the femora-tibial joint, by the wing-covers, the latter being long, pointed and ribbed; they reach to the end of the fourth abdominal segment. Near the hind edge of each segment is a dorsal ridge, bearing stiff hairs, and from three to seven unequal sharp spines, which on the sixth segment are arranged in two irregular rows, with six larger than the rest, and tipped with black. On the terminal segment are two large, equal, erect, long and slender blackish spines, and a pair of ventral, sharp tubercles on the seventh segment.

Fig. 149 *a*.



Head of larva of Languria.

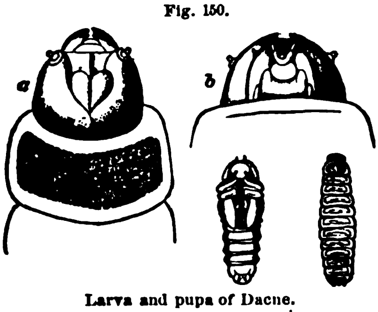
Figs. 148 and 149.



Larva and pupa of Languria.

The body is naked, whitish, with a few scattered hairs along the sides. The head cannot be seen from above, being covered by the prothorax; it is rounded oval, and free from the prothorax beneath, with a few short scattered hairs. It is about half (·50–·60) of an inch long. (Thirty specimens.)

Fig. 150.



Larva and pupa of Dacne.

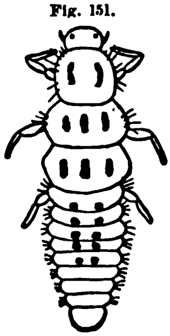
Of probably somewhat similar habits is the *Dacne heros* (fig. 150, larva and pupa; *a*, upper, *b*, under side of head), the early stages of which have been communicated to me by Dr. H. Shimer, of Illinois. The grub of an allied species (*D. fasciata*) found in this state, is said

by Candèze to live about New Orleans in the diseased trunks of the palmetto. It is not known what tree it inhabits in this state.

BENEFICIAL INSECTS.

The Aphis-eating Lady-beetle.—Among the insects which do incalculable benefit to agriculture, are several kinds which prey almost exclusively upon the Aphis or plant-louse. The Syrphus flies in the maggot state devour great quantities, and so do the larvæ of the lace-winged fly (Chrysopa). Scarcely less valuable aids to the gardener are the young of the "Lady-bird" beetle (Coccinella). During the past summer we have traced the transformations of a species (*Psyllobora 20-maculata* Say) which lived in all its stages on the leaves of the horse-chestnut during the month of August. As no aphides were seen on the leaves, I am inclined to think that in this instance the food of the young lady-bird was certain freshly hatched Psoci (Coecilius), aphis-like neuropterous insects which were running about over the leaves, masses of their eggs being attached to the leaves, and as usual covered with a thin web. Indeed some Coccinellæ feed on the eggs and young of their own kind. This lady-bird is a very small beetle, a tenth of an inch long; pale, whitish yellow, including the legs and antennæ. There are four black spots on the prothorax, and nine on each wing-cover, two on each wing cover usually running together, thus making twenty distinct spots in all.

Fig. 151.



Larva of "Lady-bird."

The Larva (fig. 151) is long and slender, with a rather small head, which is a little over half as wide as the segment (prothorax) next to it; it is somewhat trapezoidal in form, being widest in front, a little longer than broad, with black, conspicuous eyes consisting of four or five raised facets. The stout, minute antennæ are two-jointed, the joints being of equal thickness, the second a little shorter than the first. The upper lip (labrum) is small, transversely broad ovate, with the front edge rounded. The jaws are quite small. The maxillæ are very large, obtuse cylindrical, projecting far beyond the head. The labium is small and short.

The body is widest on the third segment behind the head, and shorter than the first segment, the three segments gradually decreasing in length; while the abdominal segments are nearly equal in length, and very convex laterally. The form of the terminal (ninth) segment I could not make out, as all my specimens were preparing to affix themselves to the surface of the leaf, and this segment was greatly enlarged and elongated, ending in a soft and membranous ruffle-like dilatation by which the insect was evidently about to gum itself to the leaf.

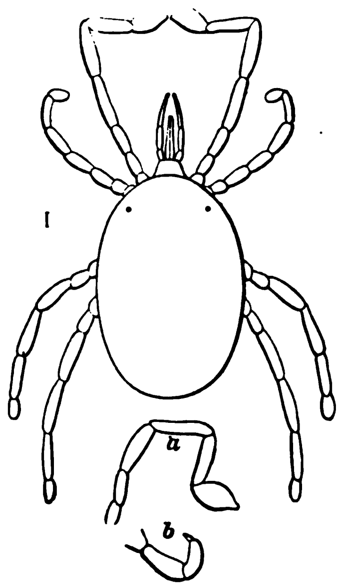
The body is covered with short, stiff hairs. It is white, with two dark spots on the segment next the head, four on each of the two following segments, and two on the five

succeeding segments; these spots are thickened portions of the skin, giving rise to hairs. The legs are stout, the toe-joint ending in a single claw, with four or five tenent hairs at the end of the joint. Length about a seventh (·15) of an inch.

The pupa is of the usual form in the group, but is white, with two faint dorsal dark spots on the middle thoracic segment, and two on the basal segment of the abdomen; farther behind is a pair of large, converging, black spots beginning on the second abdominal segment, and ending on the fourth; while on each side of the fourth are two dark spots. There are two slight dorsal spots on the fifth segment. The body is usually provided with a few fine, scattered hairs, but in a very small specimen (·06 inch long) the upper side is denseely covered with long, thick hairs, the body being naked beneath. The larger specimen measured ·12 inch in length.

The Aphis-eating Mite.—Quite an unsuspected enemy of the aphis is a little garden-mite, which I found in July and August last in considerable numbers in my garden, busily engaged in devouring the plant-lice on the rose-bushes.

Fig. 152.



Aphis-eating Mite.

We know but little of the numerous kinds of mites which abound in this country, and but few species are known to prey on other insects. The present species is allied to the red garden-mite (*Trombidium*), which is often seen running over flower beds. It is the six-legged young of these mites which, under the name of harvest-mites, are so irritating and annoying when they get upon our bodies, as they work their way in under the skin. Their natural hosts are various insects, such as grasshoppers, etc., as we often perceive them with their heads stuck in between the joints of the latter. They are all vermilion-red in color, and in former times have been used as a dye.

Our species is apparently a *Trombidium*, or closely allied genus, and perhaps the specimen we figure here is immature. It may be called *Trombidium? bulbipes* (fig. 152, *a*, leg; *b*, palpus, side view) in allusion to the swollen, bulb-like terminal joints of the legs. It is scarlet red, regularly ovate in form, with a distinct, squarish head separate from the body, and two deep-red eye-spots situated over the insertion of the second pair of legs. The beak is long, slender, sharply conical, and reaches to near the middle of the third joint of the palpi; the latter four-jointed, the second and third joints of nearly equal size, the fourth very minute; when extended the palpi reach nearly to the end of the third joint of the first pair of legs. The fore feet are much

larger, thicker, and rather longer than the fourth pair, and inserted very near the head; the terminal joint is much swollen, ovate, the preceding joint being slenderer than the others. The second pair are about half as long as the first pair. It is deep scarlet-red, and the body and limbs are densely covered with short, stout hairs.

This species, though quite different in the form of the body, yet in the proportions and form of the legs and mouth-parts is congeneric with the European *Trombidium papillosum* of Hermann, which is said to live on the trunks of trees and in moss.

THE RELATION BETWEEN THE COLOR AND THE GEOGRAPHICAL DISTRIBUTION OF BIRDS.

BY ROBERT RIDGWAY.

THE July number of the NATURALIST contains a criticism of my paper on the relation between color and geographical distribution of birds* which is doubtless by this time familiar to the readers of this journal. The tone of this criticism renders it necessary for me to reply to it; but in doing so I shall endeavor to use as little space as possible, and limit my defence to the statement of a few simple truths, which I hope will answer the purpose as well as a lengthy discussion.

The specific charges made against me are two in number: (1) I am accused of "appropriating Mr. Allen's work without acknowledgment" to the latter author; and (2) of dishonestly claiming originality in the conception of certain laws and of cases illustrating them. These charges are preferred severally in the following words: — "he writes as if his views were both novel and original, which is not the case. To speak plainly, the paper is based entirely upon Mr. Allen's views, without the slightest allusion to this author; and is illustrated chiefly by cases already published, yet without proper references."

As regards Mr. Allen's work, I am not only willing, but desirous, that he should receive all the credit due him for his well accomplished task of elucidating the laws of climatic color-

* On the relation between Color and Geographical Distribution in Birds, as exhibited in Melanism and Hyperchromism. Am. Journ. Sci. iv, Dec., 1872, p. 454; v, Jan., 1873. p. 39.

variation, and geographical distribution. This gentleman's writings place him in the foremost rank of the philosophical ornithologists of the present day; their high merit and great importance being recognized by all to whom they are familiar. I have the highest respect for Mr. Allen's works; they show careful study, deep thought, persevering search for facts, and thorough, analytical mode of treatment. About their only fault consists in the two frequent evidence of conclusions "jumped at," or based upon insufficient evidence.

But as justly as Mr. Allen deserves his high position among the most thorough and advanced ornithologists of the day, we must not lose sight of the fact that he is not the only one who has written upon the subject of climatic color-variation and geographical distribution. Professor Baird, the pioneer in this subject, so far as America is concerned, first made known the main governing laws; and thus opened the way to later researches. But even he is preceded by Dr. Gloger who anticipates *all* American writers in many generalizations of this kind, published as long ago as 1833.*

A few of Dr. Gloger's generalizations, which bear more directly upon the province of this paper, are the following:

"The variation in color of birds from one country to those from another, is influenced not only by the mean temperature of the year, but also by that of single months (those about the time of the most rapid growth or molt) *and by the relative time and quantity of the falling snow and rain*" (p. 10. See pp. 239-241 of Mr. Allen's paper). "Light also has influence"—in the change of color (p. 110). "Heat has influence by drying out the moisture, whereby the action producing a change is a mechanical one" (p. 71). "The fact that in some summers there are more cuckoos of a reddish brown color, or with reddish brown spots, may probably be owing to the general or periodical atmospheric constitution of the year in question" (p. 98).

In 1866, before the appearance of any of Mr. Allen's writings, Professor Baird published a paper entitled "The Distribution and Migrations of North American Birds,"† in which much was said regarding climatic variations in color and proportions. The generalizations advanced in this paper are the following:

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* Das Abändern der Vögel dursch Einflufs des klimas. By Dr. Constantin Lambert Gloger, Breslaw, 1833.

†American Journal of Science and Arts, Vol. xli, Jan. and March, 1866.

1. *Latitudinal and altitudinal variation in size* of resident species; northern bred individuals, and those born at high elevation, being larger than those born farther south or in the low lands.

2. *Absolute increase of the size of the bill, even with diminution in general bulk*, in Florida birds, as compared with individuals of the same species born north of that peninsula: the same rule applying, to a less extent, to birds from Cape St. Lucas.

3. *Longer tails of western birds than of eastern examples of the same species.*

4. Darker color of birds from the Pacific coast than of specimens of the same species from the interior, "the latter frequently exhibiting a bleached or weatherbeaten appearance, possibly the result of greater exposure to the elements, and less protection by dense forests."

Here then are three laws of climatic or regional variation in size and proportions, and two of color, in which Mr. Allen is anticipated by Professor Baird. But without going farther into the literature of the subject, I will proceed at once to discuss Mr. Allen's celebrated work published in 1871,* in order to show wherein he has anticipated me in the announcement of generalizations, in cases illustrating them, or in reducing specific names to the rank of race, or "variety," names. On p. 235, the law of increased intensity of color to the southward is announced, this not having been especially noted by previous writers (though Gloger says something indefinite in relation to it in his work above cited). This law, then, originates with Mr. Allen. The cases which he cites in illustration are the following: *Quiscalus purpureus*, *Agelaius phœniceus*, *Ortyx Virginianus*, *Sturnella* "*Ludoviciana*" (= *magna*), *Galeoscoptes Carolinensis*, *Harporhynchus rufus*, *Centurus Carolinus*, *Picus pubescens*, *P. Gairdneri*, *Colaptes auratus*, *Thryothorus Ludovicianus*, *Troglodytes ædon*, *Geothlypis trichas*, *Pipilo erythropthalmus*, *Buteo lineatus* and *Bucephala Americana*(!). The idea of "the so-called *Bucephala Islandica* being the larger northern type of *B. Americana*, in which the white markings on the head and wings occupy a somewhat larger area," is entirely erroneous, as every one acquainted with these very different species

*Bulletin Mus. Comp. Zoöl., Cambridge, Mass., ii, 1871. Part III. On Individual and Geographical Variation among birds, considered in respect to its bearing upon the Value of certain assumed Specific Characters, pp. 186–250.

will admit. The other cases cited show only slight (sometimes inappreciable) manifestations of this law within the territory of the United States. Thus none of my cases were "already published," and, besides, all were in a new geographical field.

The laws of variation with longitude, which Mr. Allen lays down, are the following:

1. *Brighter colors of the birds from the interior, than of those from the Atlantic States;* with a tendency to more ferruginous tints in some species and to melanism in others.

2. *Brighter or darker colors of the birds from the Pacific coast (especially north of the 40th parallel) than of those from the interior.*

3. *Lighter colors of birds from the arid, sterile plains than of those from either the eastward or the westward.*

By referring to this paper, it will be seen that all the above laws are substantially the same as in the generalizations made by Professor Baird in 1866, so that they were at the time of the publication already "the common property of ornithologists;" while the proposition that red areas "spread," or enlarge their field in proportion as we trace certain species toward the Pacific coast, and that in the same proportion yellow often intensifies in tint, is a law of which Mr. Allen makes no mention, and which is, so far as he is concerned, original with me; at the same time I claim originality for the cases illustrating both this and the foregoing laws, though I have never thought before of claiming either the generalizations or the examples as discoveries of my own.

Having given my defence as far as Mr. Allen is concerned, I shall now attend to the cases in which I reduced previously recognized "species" to the rank of geographical races, or "varieties," "the implication being, that such nomenclature, and the views sustaining it, are novel." Dr. Coues professes to have anticipated me in several of these cases by using the same nomenclature in his "Key," and other previous works. How far he is justified in this it is my purpose to show.

The case of *Chrysomitris*, Dr. Coues claims to have "first worked out, in 1866 (Proc. Phila. Acad., 81), exactly as it is here presented, although *C. psaltria* was not there formally brought into this connection, as it has since been by us (Key, Oct., 1872, 132, 133)." How much Dr. Coues is entitled to make this assertion

may be judged from the following summary of his views, as expressed in the first work to which he calls attention :—

138.* CHRYSOMITRIS (PSEUDOMITRIS) *psaltria* (Say) Bonap.
139. CHRYSOMITRIS (PSEUDOMITRIS) MEXICANUS (Swains.) Bonap.
[A. Var. *mexicanus* Swains.]
[B. Var. *columbianus* Lafr.]
[C. Var. *arizonæ* Coues.]

Dr. Coues' reasons for keeping *psaltria* apart from *Mexicanus* and its varieties are explained by his own words, which we quote from p. 83 of the first paper cited :— . . . . "the typical *psaltria* is so very diverse from *mexicanus* proper, and the doubtful specimens" (meaning var. *Arizonæ*) "incline so very decidedly toward the latter, that, in the impossibility of uniting *psaltria* with *mexicanus*" (!!!) "we must consider them" (the doubtful specimens —var. *Arizonæ*) "as varieties of the latter, unless, indeed, they be hybrids between the two." Thus it is very plain that *C. psaltria* was not then formally brought into the connection in which I placed it. My arrangement of these forms was as follows:

CHRYSOMITRIS PSALTRIA, Say.

a. Var. *psaltria* Say. Rocky Mts. of the U. S.
b. Var. *arizonæ* Coues. U. S. and Mexican boundary.
c. Var. *mexicana* Swains. Mexico and Central America.
d. Var. *columbiana* Lafr. Isthmus of Panama and adjacent localities.

In discussing the relationship of these forms to one another, Dr. Coues does not even note the progressive increase of black from *psaltria* to *Columbiana*—much less does he appear to consider the manifestation of any climatic law affecting color as applicable in this case—but merely gives the comparative characters of the several races, and remarks, incidentally, that there is a gradual transition between the two extremes (*Columbiana* and *Arizonæ*—*psaltria* being positively separated from the series, as a distinct species, in the manner shown above). As regards "bringing it into the connection" of a race along with *mexicanus* in the "Key," Dr. Coues may, perhaps, remember the occasion upon which I explained the case to him, illustrated it by a series of specimens, and discussed the matter with him without hesitation.

In the treatment of the races of *Myiarchus Lawrencii*, I certainly cannot be justly charged with "scientific plagiarism," since

* The current number of his catalogue.

I present the case in an entirely different light from Dr. Coues, as the following schemes of arrangement will show:

(Coues' arrangement).	*(Ridgway's arrangement).*
6. MYIARCHUS LAWRENCII.	1. MYIARCHUS LAWRENCII (Giraud).
Tyrannus lawrencii Giraud, } Syn.	*a.* var. *lawrencii* Giraud—N. Mexico.
Myiarchus nigricapillus Cabanis. } Syn.	*b.* var. *nigricapillus* Caban.—S. Mexico and Central America.
7. MYIARCHUS NIGRICEPS.	*c.* var. *nigriceps* Sclater —Panama to Ecuador.
Myiarchus nigriceps Sclater, } Syn.	
" *brunneiceps* Lawr. } Syn.	

Each of the three races which I recognize is characterized by perfectly tangible distinctive features; var. *nigricapillus* is well marked by conspicuous characters which distinguish it from both the others, notwithstanding that Dr. Coues "cannot make out that it is even a recognizable variety." The simple fact that in the series I recognize but one species, with three geographical races, and apply scientific principles in showing the gradual transition from one extreme to the other, and at the same time show the direct relation between this progression and a certain climatic law of color-variation, while he recognizes, in effect, two species, without any varieties, and does not discuss any law or generalization at all, shows how unjust are his pretensions to have anticipated me in this case. These pretensions may, perhaps, be considered the more unjust from the fact that the material upon which Dr. Coues based his monograph of this genus had been previously overhauled by me, thus giving him the benefit of my unpublished determinations, which were in many cases indicated upon the labels —though it is but due Dr. Coues to say that he acknowledged in one case the source of his information (see p. 67, Proc. Acad. Nat. Sci., July, 1872).

I do not claim originality for calling *Picus Harrisii*, "*villosus* var. *Harrisii*," but merely—as any one can see—cite it as an instance illustrating increased melanism toward the Pacific coast. For calling *Sphyropicus ruber*, "*varius* var. *ruber*," however, *I do* claim originality, notwithstanding the fact that this way of "putting it" was first done in the "Key." I well remember, though perhaps Dr. Coues may not, the occasion upon which I unhesitatingly told him of my discovery, and satisfied him of its merit by laying out a series of specimens to illustrate my theory. At that time he certainly had not thought of combining *S. ruber* with *S. varius*, as a geographical race, along with *S. nuchalis*, but the length of time elapsing before the publication of the "Key" (perhaps a

year) no doubt justifies his lack of recollection as to how he got the idea.

The statement in regard to *Cardinalis* is erroneous in several respects: first, I did not make "a new Mexican variety, *carneus*, of *Cardinalis virginianus*," but gave the synonymy of that previously named race, citing Lesson first, and Bonaparte's Conspectus next, as authorities for the name, which I merely reduced to the rank of a race. The new race which I characterized was *coccineus* Ridgway, from eastern Mexico, while *carneus* Lesson was from the western coast. In reducing *C. igneus* of Baird to a variety, I did not follow "a previous writer" (Key, p. 151 cited) since, as explained further on, I had not seen the "Key" until after the printing of my paper.

In the case of the western forms of *Cyanura* I am perfectly willing to renounce all claims to originality, for if my method of treating them contributes to the better understanding of the relation which they bear to each other, my aim is accomplished.

So far as Dr. Coues' "Key" is concerned in the matter of nomenclature, it must in this instance be ignored, as the following facts justify: Though the "Key" was published in October (1872) and my papers not until December and January following, yet I never saw the pages of that work until after the issuing of my papers, which were written and forwarded to the publishers the preceding July or August, at which time I had not seen the "Key" at all. Even had I seen and been perfectly familiar with its pages, I could still claim with perfect right, for reasons stated farther on, originality for the nomenclature which I used.

And now, having justified myself in regard to the relation which my paper held to previous publications in specific points, let me say a few words in its defence on general principles. From the time when its preparation was first discussed in my mind to the time of its publication, the question never once occurred to me whether the laws which I endeavored to explain were my own discoveries, or whether their discovery was the property of others. I took it for granted, that the subject and its general principles were so familiar that a preliminary review of its literature would be a superfluous addition to a paper already overburdened with references — of which, very singularly, my reviewer complains of a meagreness. My only view was to begin at once with these laws, state as precisely and briefly as possible what their prin-

ciples were, and illustrate them, *purely in the interest of science*, by novel cases and, when possible, by the cumulative evidence of familiar cases. If I have succeeded in contributing a few unfamiliar facts to the store of science (and the hope that I have is encouraged by the fact that my reviewer has had the courtesy to approve of the treatment of some cases, and to acknowledge the merit of an occasional novelty) I am much gratified; and consider myself well paid for my labors. To be charged with literary theft must be unpleasant even when it is merited; but to be falsely branded with "scientific plagiarism," without any provocation, is an accusation which cannot be borne in silence. In this case, the charge bears with it so much arrogance, that a simple defence against it is not sufficient; and I should consider myself very selfish and uncourteous did I not make some return for the marked attention which I have received. I therefore deem it my duty to state here, that the several examples alluded to above are but a fraction of the number of cases in which I have suffered from my indiscretion of being too trustingly communicative, and from Dr. Coues having taken advantage of earlier means of publication.

Should my reviewer realize the truth of his preliminary remark, that "the critic's office is not seldom ungracious," I am sure that I feel very sorry that he made up his mind not to "shirk the responsibility" in which the tone, more than the matter, of his criticism involved him.

REVIEWS AND BOOK NOTICES.

Antiquities of the Southern Indians.*—The author expresses the hope that the pages of this volume will, "at least, in some degree, minister to the information and pleasure of those who are not incurious with regard to the subject of American archæology;" and we think in this he will not be disappointed. There certainly is a large amount of valuable information in the twenty-two chapters of the work.

The several works that have now long been the text books of

*Antiquities of the Southern Indians, particularly of the Georgia Tribes. By Charles C. Jones, Jr., 1873. 8vo, pp. 532. Illustrated. Cloth.

North American archæology have all drawn a broad distinction between the so-called mound-builder and the Indian: although in the elaborate monograph of Messrs. Squier and Davis, there is much that belongs either in common to the two races, or the various relics of both have been mixed up. Even as far east as New Jersey, the various forms of relics found in the mounds have been discovered except one class of pottery, and possibly the "animal" pipes.

That the two peoples were not the same—that the present red-man was not the descendant of the mound-builder, has been and is the general opinion, and yet it is difficult, in very many cases, to say of many "finds," *this* is mound-builder and *this* Indian. So the precise relation the two peoples bore to each other is as desirable a problem to solve as to trace out the exact origin of either. It was this latter thought especially that has been suggested by every few pages of the volume before us.

The first nine chapters, giving admirable descriptions of the various mounds in Georgia, recall the many mounds examined by Messrs. Squier and Davis, throughout the Mississippi valley; and we are carried back to the remote time of the occupancy of the country by this mysterious people. Mr. Jones, with his descriptions of the mounds, adds a most admirable account of the manners and customs (as they were) of the Indians, but we ask, Did they build these mounds? The author says, in this connection—"In the light of the Spanish narratives, after a careful consideration of the relics themselves, and in view of all the facts which have thus far been disclosed * * * * we see no good reason for supposing that these more prominent tumuli and enclosures may not have been constructed in the olden time by peoples akin to and in the main by no means farther advanced in semi-civilization than the red-men native at the dawn of the historic period. In a word we do not concur in the opinion, so often expressed, that the mound-builders were a race distinct from and superior in art, government and religion, to the southern Indians of the fifteenth and sixteenth centuries." This is something new in the later speculations concerning the American aborigines, scarcely borne out we think by a careful survey of the antiquities of the whole country. Indeed Mr. Jones himself shows that mound-building races preceded the Indian, and such passages as the following frequently occur,—"The Creeks did not claim that

these tumuli were erected by them. They declared that they were here when their ancestors first possessed themselves of the region." Now if these mounds were deserted by their builders previous to the occupancy of the country by the Creeks or other Indians, it would seem probable that they were a different people. Had they been driven away by the Indian, then the latter would have a traditional recollection of that event. It is not possible to trace any connection, near or remote, between the mound-builder and the Indian; and if the latter were a degenerate offspring of the former, would not some trace of a tradition still remain with them of their ancestors' superiority in art, government and religion?

As the contained relics of themselves go but little way towards elucidating mound history, may not these Georgia mounds have been built by Indians? by some race preceding those that last occupied that territory? for the red-man is certainly given to roving. Like relics do not prove like races, and do like mounds? On this very point, Mr. Squier has expressed an opinion concerning the mounds of New York, which is applicable here. He says of these mounds, that "the resemblances which they bear to the defensive structures of other rude nations, in various parts of the world, are the results of natural causes, and cannot be taken to indicate either a close or remote connection or dependence. All primitive defences, being designed to resist common modes of attack, are essentially the same in their principles, and seldom differ very much in their details. The aboriginal hunter and the semi-civilized Aztec selected precisely similar positions for their fortresses, and defended them upon the same general plan; yet it would be palpably unsafe to found conclusions as to the relation of the respective builders, upon the narrow basis of these resemblances alone." These remarks are applicable here, because we do not yet know what relation these Georgia mounds bear to the unquestionably archaic structures of the Ohio and Mississippi valleys. We still believe that the mound-builders were a different people from the Indians, and had the relics of each been separated and treated of by themselves, we think more light would have been thrown upon American archæology by the first half of Mr. Jones' work.

Chapters x to xxii, inclusive, are devoted to the enumeration and description of the relics found in the mounds and graves and on the surface generally: the latter relics being, as they are in New

Jersey, very numerous on the sites of villages and scattered in fewer numbers wherever game had been followed by the dusky hunters. These relics as a rule differ in no way from such traces of the aborigines found in the middle and northern states. Mr. Jones claims, however, that a greater degree of skill is exhibited in the workmanship, especially of their arrowpoints, by the southern Indians; and we have no doubt but that such was the case to a certain extent: that is, that there is obtained in Georgia a larger percentage of jasper and quartz arrowpoints, which are always more delicately chipped than those formed from softer minerals. We must, however, call attention to the fact that the fifty-three illustrations given do not indicate extraordinary skill, nor have we a drawing of "almost every known form," which the author says "finds here (in Georgia) its type." The most interesting specimens of stone implements figured by Mr. Jones are the sword, pl. xii, fig. 4, the dagger, fig. 3 of same plate, and the axe with stone handle, pl. xii. In our own experience in collecting, we have never met with any relic resembling them; although we have frequently heard of an axe, with a handle of stone, but have always failed to find its present whereabouts. The similarity of our American stone implements to those found in Europe makes the dagger peculiarly interesting, as it renders that form common to the two countries.

In describing the pipes, idols and pottery of Georgia, we think the author has pretty thoroughly confounded Indian and mound-builders' relics. The idols, "animals," pipes and some of the vases, we should consider as belonging to the latter people: while the plainer pipes and fragments of pottery figured are such as are abundant throughout the whole country.

While students of American archæology owe much to Mr. Jones for the vast amount of information he has made accessible to them, by the publication of his interesting work, we think it is to be regretted that the great distinction between mound-builders and Indians has not been admitted by him, for having had an opportunity in Georgia of carefully studying the many traces of each race, the distinction between them, carried out in one volume, would have long been a most valuable guide to those who, in other portions of the Union, may wrest from destruction and preserve to science the rapidly disappearing relics of the ancient peoples of America.—C. C. A.

THE CHILDHOOD OF THE WORLD.*—This tastefully printed little book will not, we think, disappoint those who take it up, provided they expect no more than what the author states in the preface to be its scope and aim, which are "to narrate, in as simple language as the subject will permit, the story of man's progress from the unknown time of his early appearance upon the earth to the period from which writers of history ordinarily begin."

"As the Table of Contents indicates, the First Part of this book describes the progress of man in material things, while the Second Part seeks to explain his mode of advance from lower to higher stages of religious belief."

The first part, which is the shorter of the two, is too brief, and scarcely sets forth the claims of prehistoric archæology to the rank of a science; although the author very properly states the main fact of that science, more than once, *i.e.*, the very great antiquity of man. We think that he is too brief, in this first part, because it is possible he may not have said enough to excite the young reader's attention and curiosity, and so cause him to look further into the subject of archæology, which offers so wide a field for research.

Mr. Clodd believes that man was created *de novo*, and not developed, and starting with that assertion, notices in detail, "Man's first wants," his tools; then fire, cooking, pottery, the use of metals, and then touches upon language, writing, counting, and man's wanderings about the globe; holding throughout, apparently, that all men have sprung from a common origin, which we think by no means demonstrated. At any rate, climate, to which he refers on page 47, and "the land they dwell in," will not of themselves explain the variation now existing between the several distinct types of mankind. Nor can we admit as true, the statement that America was peopled by tribes who "leapt across the narrow straits between Asia and America and wandered over that vast New World." This "leaping across narrow straits" does not appear to us to accord with the traces of archaic man already discovered in this country, as "the contemporaneity of man in America with the mammoth and mastodon may be regarded as being satisfactorily established" and when we go back so far

* The Childhood of the World; A Simple Account of Man in Early Times. By Edward Clodd, F. R. A. S. London and New York: Macmillan and Co., 1873. Crown 8vo, pp. 118. Cloth.

into the past, do we find reason for believing the straits were then as narrow as now? May not an ocean have rolled between, or ice blocked up every portion of the way? In the second part, the researches of Max Müller, Tylor and others as to myths and worship in its various forms, are very clearly outlined, and, we doubt not, will be read with pleasure by all who purchase this little volume. We hope, with the author, that the subjects treated of may rouse a curiosity which will lead to the careful study of the works of Tylor, Lubbock, Nilsson, Waitz and other ethnologists, from which Mr. Clodd has so largely drawn in his brief account of Man in Early Times.—C. C. A.

Catalogue of the Phænogamous and Vascular Cryptogamous Plants of Canada and the Northeastern Portion of the United States.*—This is somewhat on the plan of the British exchange Catalogue which was in use twenty years ago. It is printed in eight pages of large quarto size, each of six columns. The portion of the United States included is co-extensive with that of "Gray's Manual" with the addition of a range of states on the western side of the Mississippi; namely, Missouri, Iowa and Minnesota.

An ingenious arrangement indicates the geographical range of each species, *i. e.*, its occurrence in either or all of three districts, *viz.*: 1, Canada; 2, Virginia; 3, Illinois; respectively representing the northern, the southern and the western distribution. The Catalogue extends to varieties, is very carefully prepared, evidently with much pains, and is admirably adapted for its purpose; that of facilitating exchanges among botanists. Mr. Curtiss, as one of our most active botanists, has doubtless felt the need of what he has now supplied.

Bulletin of the Buffalo Society of Natural Sciences.†—A new life is pervading this society, perhaps due to the removal of Mr. Grote, the well known lepidopterist, from the south to Buffalo. The first number of its Bulletin contains the four following valuable papers on moths by Mr. Grote, which will greatly interest lepidopterists. "Description of New North American

* Catalogue of the Phænogamous and Vascular Cryptogamous Plants of Canada and the Northeastern Portion of the United States. By A. H. Curtiss, Liberty, Bedford Co., Virginia.

† Bulletin of the Buffalo Society of Natural Sciences, Vol. I, Nos. 1 and 2, Buffalo, N. Y., 1873. With 3 lithographic plates. 8vo. pp. 128, $2.50 a vol.

Moths," "Catalogue of the Sphingidæ of North America," "Catalogue of the Zygænidæ of North America," "Conclusions drawn from a study of the Genera Hypena and Herminia." The second number, which was recéived by us on Aug. 2d, contains two more plates of moths illustrating two papers by Mr. Grote entitled "Contributions to a Knowledge of North American Moths" and "A Study of North American Noctuidæ." It also contains a paper of thirty-two pages of "Descriptions of New Species of Fungi," by Chas. H. Peck.

We congratulate the society on the very creditable appearance of these two parts of its first volume, and think that it will find this prompt publication of papers read before its meetings of far more value to the authors in the matter of priority than the documents it has sent out regarding them.

BOTANY.

The Fertilization of Grasses.—Prof. Hildebrand, a German botanist who has paid great attention to the subject of the fertilization of flowering plants, has recently made an important series of observations on the fertilization of grasses, and especially of cereals. The agent of fertilization in all grasses, except those few in which the flowers never open, is the wind, insects apparently playing no part in it. With this object the pollen grains are very fine and smooth, so that they are at once dispersed by a breath of air; the filaments are usually not stiff, but versatile, and the stigma is either feathery, or presents a large surface with numerous indentations in which the pollen is easily lodged. These contrivances render cross-fertilization inevitable; and, while self-fertilization is in most cases not absolutely prevented, it is generally rendered very difficult. Many species, however, which are ordinarily cross-fertilized never open their flowers when the weather is cold and rainy, and are, in such circumstances, necessarily self-fertilized. In grasses with unisexual flowers, cross-fertilization must take place as a matter of course. In those with hermaphrodite flowers a few are protogynous, and hence also necessarily cross-fertilized. In the larger number of grasses, however, the male and female organs are developed at the same time, and special contrivances occur for ensuring cross-fertilization. In the rye the position of the organs is such that a part of the

pollen from one flower must almost necessarily fall on the stigma of another flower. In the wheat each separate flower remains open only for an extremely short time, the glumes separate from one another suddenly, the anthers immediately protruding, and a large quantity of the pollen is dispersed into the air, the whole process not occupying more than half a minute. In most of these cases the stigma remains receptive only for a very short period and then dies, while in others the stigma remains in a receptive condition till long after the anthers have dropped off, and then must necessarily be open to the access of foreign pollen. In comparatively few cases the natural contrivances appear to favor self- rather than cross-fertilization. Thus in the oat and barley the majority of the flowers never open, and are, therefore, necessarily self-fertilized; there appear, however, in almost all cases to be a small number of flowers, often arranged in one or two separate rows, which do open, and therefore may introduce occasional cross-fertilization. It is probable that the same species behaves differently in relation to its arrangements for fertilization under different circumstances of climate, while species very nearly related exhibit phenomena which offer a marked contrast.—A. W. B.

Structure and Propagation of Lichens. — The theory of Schwendener that Lichens are not separate organisms but are composed of Fungi, parasitic on Algæ (the so-called gonidia), has not, up to the present time, found much favor with cryptogamic botanists, Sachs being almost the only physiologist of repute who has as yet adopted it. The theory has, however, recently met with some countenance from the researches of Woronon on the lichens *Parmelia pulverulenta* and *parietina*. He confirms the previous statements of Famintzin and Baranetzky that the gonidia of these lichens produce zoospores which he describes as bi-ciliated; and he gives an exact account of their mode of escape from the gonidia. These zoospores, after the cessation of their vibratile motion, caused by the cilia, become covered by a membrane after the ordinary mode of the zoospores of Algæ, and form themselves into gonidiform bodies, increasing by division, but producing neither filaments nor hyphæ, but only giving birth to new gonidia, in other words, to young individuals of a unicellular alga of the genus Cystococcus. The observation of the actual germination of the zoospores is a link in the chain, hitherto wanting.—A. W. B.

CLEISTOGENOUS FLOWERS IN VIOLA STRIATA. — When we take Gray's Manual, and find no mention of a striking fact, we conclude that what is not known to so excellent a botanist must be new. Yet to me the production of cleistogenous flowers by *Viola striata* is so old a fact that only its omission from the manual leads me now to refer to it.*

The Manual confines the production of these flowers to the acaulescent species which it says "produce apetalous flowers from underground stolons during summer." *V. striata* belongs to the leafy-stemmed section, and produces an abundance of these flowers from midsummer till frost. In early spring the petaloid flowers come out from the axils of the four lowest nodes; six or eight nodes are then formed, in which the axillary bud is developed into a branchlet instead of a flower, and all the succeeding nodes bear leaves with apetalous flowers from the axils, which produce seed very profusely.

Physiologically speaking there is nothing remarkable in this. As suggested in my remarks on *Fragaria* "*Gilmani*" some years ago, a stolon or runner is but an upright caulis which has lost the power of erection, and characters common to one easily appear in the other with little or no modification.—THOMAS MEEHAN.

SPHAGNUM AND HYPNUM PEAT.— The opinion seems to have been somewhat prevalent that peat does not accumulate abundantly in limestone regions, but this is not true of large portions of some of the northern interior states. For example, all the peat of Iowa is in an eminently limestone region and the water taken out of any of the marshes shows a strong reaction for lime by proper chemical tests.

From my own observations I believe that Sphagnum peat does not accumulate in limestone regions, but that the peat mosses of such regions all belong to the genus Hypnum. I have found no other moss entering into the composition of Iowa peat.

Another fact observed in this connection has doubtless much significance, namely; the Ericaceæ are almost entirely wanting in Iowa, and no plants of that order have yet been observed by myself in or about these Hypnum marshes. The principal plant assisting the Hypnum in the production of peat is a kind of grass.

Should one go north from Iowa or Illinois into the metamorphic

* It is well known in *Viola canina* of Europe, and here in *V. Canadensis*.—EDS.

regions of Minnesota and Wisconsin, I think he would see the Hypnum gradually give place to Sphagnum in the marshes, and the marsh Ericaceæ appear with the last named moss.

In short, lime seems to be an uncongenial element in the habitat of both Sphagnum and most if not all ericaceous plants, but is not uncongenial to Hypnum and grass. Therefore the abundant presence of lime will not necessarily prevent the accumulation of peat.—C. A. White.

ZOOLOGY.

Centronyx "ochrocephalus" *Aiken*.—This nominal species, described by Mr. Aiken in a recent number of the Naturalist,* is neither entitled to specific rank, nor even to a name as a well marked variety or race. This deduction I have adopted after a careful examination of the two specimens of it collected—one, the type, in the museum of the Smithsonian Institution, the other in the collection of Mr. R. Ridgway—and their comparison with Audubon's type of *C. Bairdii*. The color differs in the two types very appreciably, indeed as much and even more, than in many well established and closely allied species: but while the specific distinctness of these is sustained by large series of specimens in which there is scarcely any gradation, or a too close approximation in coloration, the validity of the *C. "ochrocephalus"* is entirely overthrown by the second specimen obtained, which is exactly intermediate in color, as it is in season of collection, between the first and the single specimen of *C. Bairdii*. The emarginate tail of Aiken's sparrow, as compared with the doubly rounded one of Baird's, has little weight as a character. The *C. Bairdii* undoubtedly possessed this feature, as is apparent from the appearance of the plumage, which everywhere exhibits a worn and bleached surface: and in some places the vanes at the tips of the feathers are worn quite off from the shafts; this is especially noticeable in the rectrices. The most cogent reason for considering it distinct from *C. Bairdii* lies in the differences in their relative size and proportions—*C. "ochrocephalus"* being considerably the larger; but, even in this, it does not exceed the proportion of variation which should be recognized as occurrent in a species.

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*Vol. vii, p. 237, 1873.

In regard to the new thrush (*Harporhynchus Bendirei*) recently described by Dr. Coues,* it is probably identical with Mr. Ridgway's var. *Palmeri*.

The maximum number of species in the genus Harporhynchus was undoubtedly reached some time ago: and an enthusiastical Darwinian could be censured but mildly for considering the series as representatives of a single species, the most aberrant forms being looked upon as incipient species.—DAVID SCOTT.

WHO FIRST DETERMINED THE TRUE POSITION OF HYALONEMA.—While sympathizing with the spirit of Mr. Chapman's criticism of Prof. Thomson in the current August number of the NATURALIST, we must say that he is not quite correct when he asks: "Why therefore does he [Dr. Thomson] unjustly ignore the fact that Dr. Leidy was the first to describe correctly the position of Hyalonema, by saying we had been looking at the sponge upside down, and that it had never occurred to any one to reverse it?" Dr. Leidy's article is in the NATURALIST, Vol. iv. This was in January, 1871. Doubtless Dr. Leidy's article was written the year before. In the NATURALIST, Vol. iii for 1870, is an interesting review of Scandinavian work in Natural History done in the years 1867–8. On page 216 in reference to Prof. Lovén occur these words: "the same celebrated author's ingenious memoir on the little stalked pyriform deep-sea sponge, from Finmarken, termed *Hyalonema boreale* Lovén, by means of which he demonstrated that the Lusitanian and Japanese glass-ropes had hitherto been erroneously represented as if turned upside down." In the article on "The Glass Sponges," in the "Popular Science Monthly" for this month, I have endeavored to do justice in this matter to all concerned.

In regard to Prof. Lovén's *Hyalonema boreale*, it should be mentioned that C. Wyville Thomson in his book, p. 113, says: "It is certainly very far from *Hyalonema*. It is more nearly allied to *Tethya*, for the body of the sponge must certainly be referred to the corticate type, though it differs from all the other known members of its order in being supported on a long symmetrical stalk formed, as Professor Lovén has shown, of sheaves of short spicules bound together by horny cement." But this in no wise affects the soundness of the Professor's demonstration.—S. L.

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*American Naturalist, Vol. vii, p. 330, 1873.

Passage of Specific Characters from one Genus to Another.—I find among the *Acrididæ* from the west a case which would seem to go far toward confirming the opinion of Prof. Cope, that often specific characters pass over from one genus to another.

The *Acrolophitus hirtipes* Thos. (*Gryllus hirtipes* Say) forms a very distinct and somewhat peculiar genus; the specific characters are also very distinct and well marked. During my connection with the United States Geological Survey, in charge of Dr. F. V. Hayden I have frequently met with this species in Colorado, northern New Mexico, and Wyoming, but nowhere else in those territories or in northern Utah, Idaho, Montana, Nebraska, Kansas or Dakota have I met with any closely allied species. Recently the Orthoptera collected by Lieut. Wheeler during his Explorations in Arizona have been submitted to me for examination; in that collection I find specimens which, in specific characters including even color, agree exactly with *A. hirtipes*, but differ in two prominent generic characters.

In Acrolophitus the chief generic characters are, an erect, conical vertex (which alone distinguishes it from all other American species of *Oedipodini*); a sharp elevated crest on the posterior lobe of the pronotum; posterior margin of the pronotum acutely angled. The species collected by Lieut. Wheeler has the erect, conical vertex, but the pronotum is without a crest or even a medium carina, and the posterior margin is obtusely rounded, yet the general form, size, etc., even to the hairs on the legs, are the same in both species; the color is exactly the same throughout.—C. Thomas.

Occurrence of the Rock Wren in Iowa.—*Salpinctes obsoletus*, not previously found east of the Rocky Mountain region, was observed by the writer last fall in Decatur county, Iowa. It was seen on several occasions, far out on the prairie, running over the ties on the railroad track, retreating when alarmed, into the dense prairie grass.—T. M. T., *Garden Grove, Iowa.*

MICROSCOPY.

Apertures of Objectives.—It is now certain that nothing can be easier than to get more than 82° of rays through a balsam object and immersion objective, and that those accomplished microscopists who maintained the contrary were in error in resting

their mathematical argument upon the improved assumption that the conditions under which the law of reduced apertures operated were, and must necessarily be, the same in all objectives as in those which were in their hands. This fallacy in the mathematical argument has been already pointed out in this Journal, as well as by Dr. J. J. Woodward in the "Monthly Microscopical Journal." Now that the doctrine of the limitation of the balsam angle of objectives, plausible and strong in seeming to rest upon well known facts, is removed from the way of progress in the science it was designed to assist, it remains to discuss the means of accomplishing an increase of this angle, and whether such increase may add to the working qualities of the objectives possessing it. Mr. Tolles, who must be admitted to have been the first to claim such increase of angle, believes it to be a valuable addition to the powers of objectives. The following letter from him contains some further discussion of the means of increasing the balsam angle, as well as some claims in regard to his personal relation to the controversy.

Dr. R. H. Ward, *Sir*:—I have read your notice, in the July Number of the Naturalist, of a current discussion as to possible balsam angular aperture of objectives. I am gratified at its evident spirit of fairness; and will ask that, in the same temper, you will give place to some strictures of my own.

The $\frac{1}{10}$ measured in London had, and has, no point of adjustment where with appropriate cover thickness the definition would not be good. Its highest angle, when immersed in water, is about midway of the total adjustment, and at this point corrects for $\frac{1}{75}$ inch cover. All this I will show you any time; also, Dr. J. J. Woodward has verified the same.

There is no secret as to the mode of action and the plan. The theory has been openly declared in every article of mine having the form of reply to Mr. Wenham since his first denial of validity of my first "experiment." Thus, while admitting and declaring the reduction of refraction at the first plane surface, by immersion in a more refractive medium than air, every suggestion on my part has been of *some way of making up for that loss.* You say I appeal to facts not discussing principles. What induced my first experiment was a clear apprehension of law, and the result was confidently asserted beforehand. I have never denied that the air

angle of (close to) 180°, after the first refraction, was necessarily reduced to 82° (closely) by crown glass plane surface, and by heavy, flint plane surface to 76° (closely). That is and has been understood, all around; though produced and constantly reiterated as an answer to my claims, not only by Mr. Wenham, but volunteered with much rudeness from another quarter.

You comprehend the case perfectly when you say, "This reasoning assumes only that the extreme ray above the front combination, capable of entering into the image when the objective is worked dry, is the extreme also when adjusted for immersion work." But it would be equally true to say, "the extreme ray above the front" *surface* "is also the extreme ray, etc." In the light of this statement, what is to be understood by my March paper (Monthly Microscopical Journal, 1873) to which you allude as "practically disclaiming this doctrine of rays beyond the extreme rays dry?" Why, I suggest the one sure way of giving entrance from the denser medium into the Front of a larger pencil than before with crown glass, in just so far as the refraction of the Front in such medium approaches the refraction of crown glass in air; and, behold! I am made to disclaim the very thing I have just done and pointed out how. However, from what you have written I know *you* will understand this: — my respondents say at once, "82° impinging on the inner front surface of the front lens will, from crown glass, emerge into the balsam without sensible deviation." Now, suppose we use flint glass; the angle at which total reflection takes place in this, when in contact with air, is not 82° (–), but 76° (about). When a pencil of 82°, however, impinges upon this plane surface of flint, in contact with balsam, it will have positive refraction according to the refractive index of flint glass *in balsam* and therefore while only 82° *in the glass* of the flint front, whether emergent or immergent would have more than that angle in the balsam. This much at least is sure and is decisive of the question. But again, if the material of the *front surface* have a refraction *in balsam* equal to that of crown glass in air, then obviously we *might* have near to 180° in the balsam, while the transmitted pencil immediately above the front surface would remain about the same as the "limiting angle" of crown glass in air, viz.: 82.° This is valid principle and reasoning, but I cannot appeal to facts in this case. The best I have done is 112° in balsam. See "Monthly Microscopical Journal" for June, 1873.

Do not suppose that this is the only way to exceed 82° in balsam practically. The 100° $\frac{1}{5}$ objective of four systems was on quite a different plan. It is, as to plan, described in the "Monthly Microscopical Journal" for March, 1872. There the inner three systems have 130° as a dry objective, the front as applied to those three serving only to admit such a pencil to the dry objective constituted of the inner three. But the $\frac{1}{5}$ tested by Dr. Woodward has, as to the inner three, an angle of 105° in air, and, as they are used, while the front has some, but slight, influence upon the pencil passing through it.

And now, to sum up, referring to my article of March, 1872, "Monthly Microscopical Journal," and diagrams. I will quote Fig. 1 and explanation as *theory*, antecedent to *fact*. The four-system objective being subsequently made and authoritatively resubstantiating the theory. (See "Monthly Microscopical Journal" for June, 1873; paper by Dr. Woodward giving the angle as 100° in balsam.) Quoting again, as to the case of the three systems, same Journal, same page, referring to Fig. 2. "What is intended is to increase the refraction of the convex surface of the front by sharper convexity, or higher refractive material, or *both*, to the extent necessary to make up for the diminution at the plane surface according to the refractive power of the medium" in which the front surface is immersed. Now the results, according to this second case, are well attested for angles considerably above 82° in hard balsam; account of all which will appear in good time for support of my theory! *i. e.*, the universally accepted theory. For balsam of refractive index the same as common crown or plate glass I will, with pleasure, show to you at any time that the angle of the $\frac{1}{10}$ objective, tested in London, is at least 90°; and *that* is the kind of balsam Mr. Wenham has constantly talked of, witness each of his criticisms on my claims. Every time he has alluded to the balsam index, he has declared it practically the same as crown glass. Of course, when hardened to resin, it may have higher refractive index and reduce the angle a little. Hence certain discrepancies as to amount of angle above 82°. For this reason, I have used the semi-cylinder, but that has, and had, another and a superior purpose. As a means of getting the actual angle, and the crucial test to decide this discussion, a much simpler method will serve. Thus, any piece of plate glass, say an inch square or upwards, and perhaps $\frac{1}{10}$ inch thick, or more or less, one

or both plane surfaces fine ground, is all that is necessary, only, be it provided, that some part of one edge be a polished or fractured surface tolerably near flat and square. Use this precisely as Dr. Woodward uses his tank, and the angle of the objective for that kind of balsam (like the glass) will be indicated along the ground surface if a little care be taken in adjusting glass to objective. Balsam, glycerine or dense oils will do to connect the objective front and glass plate, for the pencil traversing the plate will be constantly the same for a wide range of "preservative media." This cone can be marked as to its boundaries with a pencil on the ground glass, and measured with a protractor with perfect facility.

Whatever position gentlemen respondent may take now, *pro* or *con*, the end is assured, viz., a practically larger angular aperture for objects in balsam. I hope you will award these comments an insertion. Respectfully yours,

ROBERT B. TOLLES.

40 *Hanover Street*, *Boston*, *Mass*.

P. S. — Since writing the above, the "Monthly Microscopical Journal" for July, containing Mr. Wenham's reply to Dr. Woodward's article, has come to hand. I notice Mr. Wenham recommends the same ground glass plate for test of angle that I describe above, only nothing is said of connecting media. This is excellent! With air between, the cone will, with crown or plate glass, be about 81°, but if water or balsam or any known liquid replaces the air it can be more. It is the test. Some objective will be found in England, I dare say, to go above 82°.—T.

MICROSCOPICAL EXPERIMENTS WITH INSECTS' EYES.— Dr. F. W. Griffin, of the Bristol School of Chemistry, gives in the "World of Science" and in the "Monthly Microscopical Journal," an interesting note on this subject. Any tolerably mounted beetle's eye (transparent) will give some of the desired effects; but for good results the semi-globular set of "lenses" which constitutes the outer part of the compound eye should be very carefully cleaned and flattened without materially altering the form of the individual lenses. This is arranged as a transparent object under a one inch objective, and preferably a "Kelner" eye-piece, when some two thousand lenses or corneules are brought into view at once. By racking the objective up, the focus of these little lenses

is found, slightly above their surface, and in the focus of each is seen the image of an object, as for instance a fly on the point of a pen, held between the stage and the mirror. By a little ingenuity a good view can be obtained of a blind-tassel, the profile of a person standing before the window, or even of a landscape outside; though these distant and difficult objects show better by using a $\frac{1}{4}$ inch objective and a one inch lens as achromatic condenser. A swinging tassel, or a profile cut in brown paper and fastened against the glass, or a person's hand with the fingers in motion, or a watch face with the second hand in motion, are among the curious or grotesque objects that may be seen multiplied hundreds of times in the beetle's eye. When lamplight is used, it must be rendered parallel by the bull's-eye, and for really good effects the concave mirror and one inch achromatic condenser must also be used.

BINOCULARS FOR HIGH POWERS.—Mr. Wenham, finding the various non-stereoscopic binoculars unsatisfactory, and finding it inconvenient to make and mount a reflecting prism which should come sufficiently near the lenses to be efficient with the highest powers, has revived the achromatic refracting prism suggested by him to the Microscopical Society on June 13, 1860, by which the rays from each lateral half of the objective are bent towards the axis of the tube, crossed, and sent to the opposite eye of the observer. The prism, representing really two prisms cemented back to back, is made so small and mounted in so thin a tube that it can be slid down into the mounting of the objective close to the posterior lens.

STRUCTURE OF EUPODISCUS AND ISTHMIA. — Mr. Henry J. Slack has communicated to the Royal Microscopical Society some important researches on this subject, tending to confirm his previous impression that in all diatoms the silicious deposition takes place in spherules of varying dimensions and arrangement. He entirely discards such terms as "areolæ," "cellules," etc., believing that such apparent structures are merely, and always, unresolved groups of variously aggregated spherules. This structure he has demonstrated, and has repeatedly confirmed on Pinnulariæ, but with the old means of investigation he failed on Isthmia and Eupodiscus. With Mr. Wenham's new "Reflex Illuminator," however, these easily fall under the same law, the circular valve of *Eupodiscus*

Argus being composed of radiating bands of minute and closely packed spherules with intervening rows of clusters of larger spherules usually in fours, and *Isthmia enervis* revealing, in the place of its familiar reticulated appearance, an aggregation of minute spherules at different levels but of, as yet, not well determined arrangement. A Beck's $\frac{1}{5}$ objective will reveal this structure, though a $\frac{1}{8}$ is preferable; Powell and Lealand's new pattern (dry front) giving it excellently.

On the other hand, Mr. Samuel Wells of Boston, who has studied *Eupodiscus Argus* without the reflex illuminator, perceives no spherules and explains the usual appearances without them. The outer or convex surface he finds clear and smooth, except that it is irregularly dotted with depressions about $\frac{1}{8000}$ inch in diameter and extending nearly through the thickness of the valve. This appearance is verified by the binocular microscope and by sectional views obtained from broken valves, and is not varied by any change of power or illumination. The concave surface, which Moller mounts upwards and which alone was probably studied by Mr. Slack, is nearly smooth, without ridges and probably without granulation. It is covered with irregularly radiating rows of round dots with intervening blank spaces. These dots are about $\frac{1}{20000}$ inch in diameter, and with a $\frac{1}{10}$ or $\frac{1}{20}$ and Prof. H. L. Smith's apparatus for opaque illumination, they appear to be slight depressions with the bottom slightly convex; the four or more which are over each of the depressions on the other side of the valve being naturally brighter than the others, and corresponding to the groups of larger spherules of Mr. Slack.

Mr. Charles Stodder also combats the doctrine that the silicious matter in diatoms is always deposited in the spheroidal form. He still believes that the markings on ordinary diatoms are depressions and not elevations, and that the line of fracture is inclined to run through them instead of between them, and he therefore retains the terms "cellules," "areolæ," etc. His account of *Eupodiscus Argus* is so much like that of Mr. Wells, though published independently, as to suggest the explanation that they have worked at the subject together. He finds two silicious coats, the outer comparatively opaque and marked with large, thin apertures through which could be seen the inner coat with its much finer markings which vary according to focus and illumination from a spherical to a cellular appearance, and from a radiated to an irreg-

ular arrangement. Mr. Stodder used Tolles $\frac{1}{10}$ with Prof. Smith's opaque illuminator and Tolles $\frac{1}{18}$ immersion, and he is convinced that some parts of the valves are smooth, transparent, and structureless, without a trace of spherules.

NOTES.

We print in this number the proceedings of the first meeting of the Agassiz Natural History Club, organized by the students of the Anderson School of Natural History at Penikese Island. The school was, notwithstanding the unfinished state of the buildings, and many other temporary drawbacks, resulting from its isolated situations, opened on the 8th of July, fifty students being present. As we go to press the indications are that the need of such a school has been fully demonstrated, and its future success thoroughly assured. The nature of the work already done is such as will tend to make each student an original investigator. A large proportion of the members are teachers. They are learning the art of observing for themselves, gaining an insight into the modes and difficulties of research and obtaining some idea of the vast extent of the field of biology. Even after the short term of ten weeks they will return to their schools and colleges with a new enthusiasm for science-teaching, which will inevitably, if we mistake not, be shown in the other studies they may have to teach.

Though the school, at the time of writing this note, has been running but a fortnight, lectures on surface geology, the embryology of vertebrates and articulates, on physiology, physical geography, on the microscope and its construction, with practical lessons in its use, free hand drawing on the blackboard, zoological and landscape drawing, and daily dredging excursions in the yacht "Sprite," together with instructions in collecting and preserving animals, have been given. The amount of laboratory work done is most satisfactory. Large aquaria are being set up in the temporary laboratory, while the walls for the second dormitory and laboratory are going up.

Certainly the most sanguine friends of the movement have every reason to congratulate the founder and director of the school, with those associated in the work of teaching, on the good prospects of the experiment.

PROCEEDINGS of the Agassiz Natural History Club.—The first meeting of the club was held July 24, 1873. President S. F. Whitney in the chair.

Professor Agassiz, having been invited by the President to favor the club with remarks and advice concerning the best methods of work, responded very pleasantly.

Mr. E. C. Crosby read a short paper upon the genus *Bufo*. The eggs of two specimens examined numbered 8840 and 2200 respectively, counted under a lens magnifying four times. All appeared black to the naked eye, but the lens showed half of them to be ashy-brown. With a power of 75 diameters, the eggs were seen to be spherical in shape and of various sizes; the interior of each of a lighter color than its exterior. The stomach of one toad contained eight orthopterous (Locustariæ and Gryllidæ) insects and fifty-three Amphipod crustaceans with much dead grass-like matter. Some of the crustaceans were alive and moving in the stomach. The intestine and the oviduct were each sixteen inches in length. Reference was also made to the great comparative size of the femoral muscles in this genus.

Mr. C. S. Minot said he also had noticed that in toads caught near the beach, the stomach was filled with *Gammarus ornatus*. In two specimens caught early in the morning the sand-fleas in the anterior part of the stomach were still alive; in others caught just before noon they were all dead. He had also observed that in all the toads killed by chloroform, the heart continued beating, after death; while just the opposite effect occurred in mammals.

Dr. Wilder stated that when turtles and toads were killed with benzine the hearts would beat for several hours, although it, like chloroform, always stops the action of the heart with mammals; in one case a *Chysemys picta* was left for eighteen hours in a jar with an excess of benzine, yet the heart beat for several hours after the animal was opened.

Dr. Wilder also suggested that the depth (2 to 5 inches) of the hole in the turf, in which the toads are often found secreted during the daytime, might be for the sake of protection from the salt spray which must often sweep an unwooded island.

He further remarked upon the absence of any mollusks in the stomachs of those hitherto examined, although multitudes of small Littorinas are left upon the seaweed and among the stones where the Gammaroids occur.

Mr. C. S. Minot presented specimens of stratified sand and other soils from Nashaurna Islands. The remarks called out by this item caused a digression to the subject of glacial scratches upon which Prof. Agassiz made a few suggestions.

Mr. Straight offered a note upon the *Supinator longus* muscle of vertebrates. According to both Meckel and Huxley, this muscle is not found in dogs. Huxley mentioned it with a list of muscles which are generally represented in the vertebrates above fishes and which are well developed in man. Meckel names various of the mammalia in which it is found, but says it is absent in bats, the hyena, dog and some others. In dissecting the muscles of the forearm of a Newfoundland dog, July 19th, his attention was attracted by a peculiar strip of muscular fibre, scarcely three-eighths of an inch in width. In tracing it out to its distal end it was found to terminate in a small tendon, fully one-fourth the length of the entire muscle. Judging from the position of this small muscle Prof. Wilder unhesitatingly pronounced it the rudiment of the muscle known to anatomists as the "Supinator longus." It was so small that it would have been of very little if any use to the dog. It will be of interest to ascertain in what races of dogs this muscle is present, and in what absent, as we must admit it was absent in those dogs examined by Meckel and Huxley.

The President hoped that sometime the club would possess a library of reference and a cabinet for comparison. Prof. Agassiz explained in reply, that by the terms of Mr. Anderson's gift, it was possible to make the library and collections of the Museum at Cambridge, at some time, available to the Anderson School.

Professor Fernald made some interesting statements on the habits of *Crepidula formicata* Lam., upon being irritated.

Miss Shattuck reported the addition of *Betula alba*, var. to the list of the flora of the island.

Is it not a little strange that we should not have in this country a first class zoological garden? The nearest approach is the collection of animals in the Central Park, New York. Between April 1, 1870, and April 1, 1871, there were about 175 animals in this collection; they were placed in a series of buildings which surround the Museum and comprise one for the carnivora, one for the birds and monkeys, open air sheds for the bears, wolves, etc., roomy and open air cages for the eagles, domestic fowls, etc.,

and an enclosed building for the elephants, camels, and various tropical animals.

Professor Marsh, with a large scientific party from Yale College, left New Haven June 5th to continue his researches in vertebrate fossils in the Rocky Mountain region. A successful trip to the pliocene beds of the Niobrara river has already been made and the party are now exploring the eocene deposits near the Uintah Mountains. They will probably not return east before December.

ANSWERS TO CORRESPONDENTS.

H. W. H., Penn.—The plants sent for examination are as follows: No. 1. *Osmunda regalis* L.; No. 2, *Asplenium pinnatifidum* Nutt.; No. 3, *Melilotus alba* Lam.—R. H. W.

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Plain Directions for Acquiring the Art of Shooting on the Wing. 12mo, pp. 88. New York, 1873.

Third Annual Report of the Noxious Insects of the State of Illinois. By William LeBaron. 8vo, pp. 73. Springfield, 1873.

Memoirs of the Boston Society of Natural History. Vol. ii, Part II, No. 3. *On the Carboniferous Myriopods preserved in the Sigillarian Stumps of Nova Scotia.* By Samuel H. Scudder. 4to, pp. 9. Boston, 1873.

Carcinologiske Bidrag til Norges Fauna. By G. O. Sars. I. *Monographi over de ved Norges Kyster Forekommende Mysider.* Andet Hefte. 4to, pp. 34. With 3 plates. Christiania, 1872.

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Forekomster af Kise i Visse Skifere i Norge. 4to, pp. 97. Med 3 Plancher og Flere Træsnit af Amund Helland. Christiania, 1873.

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Beretning om den almindige Udstilling for Tromso Stift. 8vo, pp. 162. Kristiania, 1872.

Den Norske Turistforenings Aarbog for 1869. 8vo, pp. 189. With 3 plates. Christiania.

Om Kurvmager-Arbeide og Straafletning. 8vo, pp. 60. Christiania, 1872.

Stolevæsenets Ordning i Massachusetts. Af Hartvig Rissen. 8vo, pp. 92. Christiania, 1868.

Beretning om Det Kongelige Selskab for Norges Vel, dets Tilstand og Virksomhed i Aaret 1866. 8vo, pp. 131. Christiania, 1867.

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Monthly Report of the Department of Agriculture for July, 1873. 8vo. Washington.

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SCIENCE IN AMERICA AND MODERN METHODS OF SCIENCE.*

BY DR. J. LAWRENCE SMITH.

Fellow-associates:—We meet again at a point far distant from the one where we gathered last year, to interchange social greetings and scientific thoughts, and to form plans for future labor and usefulness. Fifteen hundred miles divide Dubuque from Portland, as the bird flies, and yet that extent of country and much more are all our own. Its living and dead treasures, with its rocks and its soil, furnish abundant study for our men of science, from which to draw rich stores of knowledge, and to direct the capital of the country to new sources of wealth.

As the members of the American Association for the Advancement of Science hold their session for a few days only, and occupy a portion of their time in interchange of social greetings among themselves and with the inhabitants of the city where they meet, that critical examination of papers communicated to the Association cannot be entered upon that otherwise would be, nor can the length of the communications and discussions be easily limited. In fact, while it would be desirable to supervise these matters more fully, such supervision is surrounded with so many difficulties that those whose business it is are forced to content themselves with an imperfect discharge of their duty.

* An Address to the American Association for the Advancement of Science, by the Retiring President. Delivered at Portland, Maine, August 22, 1873.

This too often gives rise to unjust criticisms on the part of the press, whose reporters attend the meetings with the same views as those with which they would enter a learned body of scientific men, who meet at stated periods, with short intervals, and where both time and sound criticism are bestowed upon such investigations as are communicated.

This association, in some sense, is to be regarded as an annual scientific *fête*, where the interchange of ideas outside the audience-room suggests as much, if not more, stern matter for reflection as the communications which may be read; the minds of men that have been on the stretch during the year are relaxed, and fresh pabulum and new vigor are furnished for the coming year.

It sometimes happens that many persons who attend our meetings gather erroneous impressions from them as to what the scientific men of the country are doing, and go away questioning themselves whether or not scientific societies and associations have, after all, done much for science; and conclude that while the men forming them have made many important investigations, and published them for the benefit of succeeding ages, it is to practical and obscure persons that the world is indebted for its great discoveries.

I allude to this here, as it is but recently that I have seen this assertion made in an article calculated to attract the attention of the masses, and the author of that article illustrates the fact by citing Clarke, Fulton and Morse. Now, while all honor is due to those men of skill and genius, I would ask—Who gave them the fulcrums on which they placed their levers, by which they have wrought so much in practical science and the arts of life? *It was pure science.* Without its aid Clarke's practical skill would have failed him in constructing his huge astronomical lenses; it is to the experiments on latent heat in the laboratory of Black that we owe the present steam-engine, and without which Fulton would never have ruffled the water of our rivers nor stemmed the winds of the ocean; and without the scientific thought and the grand, though inconspicuous, experiments of Galvani, Volta, Oersted, Faraday, Henry and others, no one would have ever dreamt of making a swift messenger of the lightning.

My thoughts on this subject have led me to reflect much upon scientific training in this country, both for those wishing to pursue science as a profession as well as for those desiring it only for general education.

There are, no doubt, serious errors in the scientific training that students undergo at our various universities and schools, which are too much in the habit of making short cuts in going over the fields of science. We are in fact a fast people, as it is commonly expressed, and are not content to devote patient and laborious study to pursuits that can only be mastered in that way. A short time ago, a physician writing on this same error in relation to his profession justly said that, while we have shortened distance by the railroad and the telegraph, the road to learning is the same as it was in the days of Socrates and Plato.

The student is restless to become instructor, the lecture-room enticing him from his studies before they are half mastered; consequently his instruction to others is both meagre and imperfect.

Our vast material interests draw the students from their laboratories to undertake the conducting of mines and other important works. The consequence is, bad economy reigns in most of them; and if it were not for the patient submission of the people of this country to high prices, many an enterprise would have to suspend operations.

But it is at the door of the educational institutions themselves that the greatest blame is to be placed. First of all, our universities (or rather our so-called universities) are too numerous. Nowadays every college must have a scientific school attached, else it is not thought complete; and the number of professors competent to fill the scientific chairs in all these institutions could not be easily supplied in this country. Were it possible, it would be far better to have fewer scientific schools, and to establish them on the broadest basis, with most liberal endowments, so that instruction could be imparted at some mere nominal cost to the student, and to make their examinations of such a standard that the indorsement of these several schools would be a passport to the bearer of it wherever he might seek for employment in pure science or in its applications. And furthermore, by a system of well-endowed scholarships, to retain those specially gifted with taste and talent for pure science to devote their first years to labor in that direction. Owing to these defects in our system of scientific education, American science is frequently reproached as being very deficient in pure and patient research.

Now, while admitting that our scientists have fallen short of what might have been expected of them, no one can deny that a

vast amount of scientific labor has been accomplished in this country from the time of Franklin to the present day; and in the application of science to the arts we are not far behind the most advanced nation of our own time.

I know that American scientists are looked upon by their European colleagues as in some sense piratical in their nature, simply capturing the hard-earned labors of others, applying the great truths and discoveries in science others have brought to light, and not evolving them by hard and laborious study and experiment. This is to some extent true, for the labors required of our professors, who have educated and trained minds, in the countless colleges that dot the land, are so onerous that no time is given them for the exercise of original thought and investigation.

What can a physicist, a chemist or naturalist, do who has three or four classes to teach, usually in the most elementary part of their studies? The very labor unfits him for that free exercise of the mind which leads to new ideas and discoveries. He becomes an educational drudge instead of an intellectual scientist; and whatever his intrinsic merits may be, he is in most cases sustained, pecuniarily, no better than those engaged in the commonest pursuits of life, being at the same time restricted in intellectual resources — such as books, scientific transactions, apparatus, etc.

I will, however, just here make one other plea for our men of science against any unjust comparison with those across the Atlantic. It is this. Our country is a new one, of most peculiar and wonderful features of surface, of soil, and of climate, and of untold and fabulous wealth within its bowels; it beckons every man to fortune; and with such ease are wealth and honors snatched from its overflowing lap that even men who love and honor science are drawn off their direct paths into by-ways and other pursuits, and too often leave behind them the scientific toga, which is never again assumed. In Europe it is otherwise; no temptations of this kind beset the scientist, and he delves into scientific lore, acquiring great ideas and telling them to the world, exciting their wonder; and even then the honors they acquire only bind them faster to their closets, for they are not tempted as we are.

In later years the liberality of wealthy patrons of learning and science has done much to advance pure science in this country by enabling the young and enthusiastic pursuers after Nature's secrets to give full scope to their tastes, and thus has opened to them new

fields of research so enticing that their entire lives may become absorbed in them. This is increasing every day in our country, and before very long there will be such inducements to offer to her greater minds to devote their lives to pure science that America will become as prolific in new scientific ideas and discoveries as Europe.

Let us ever bear in mind that it is *abstract scientific ideas which underlie, in these modern days, all discoveries conducive to man's progress*, from the making of a pen to the construction of a telescope; or, as Herbert Spencer well expresses it, "each machine is a theory before it becomes a concrete fact." The man of pure science paves the way, erects the mile-stones, and puts up the guide-post for the practical man. The world, long dormant to this great truth, is fast waking up to its acknowledgment; as those words *Cui bono?* (the touch-stone used by the so-called practical men) are only heard now in faint whispers, where they were formerly sounded most clamorously whenever any scientific discovery was announced.

This does not arise from any change in men; they are the same now as they were in the days of Galvani, who was doubtless regarded as a frivolous fellow, engaged in his daily experiments over the convulsions of the muscles in a frog's leg when brought in contact with two metals; but, while mankind has not changed, Galvani's experiment has, and instead of a frog being convulsed by the electric force then discovered it is a world that is now convulsed, as this same electricity flashes through those nerves of metal that stretch across land and river and bury themselves deep beneath the oceans of our globe; battles are fought, victories announced, commerce controlled, and, I am sorry to say, tyranny abetted, by that wonderful agent whose phenomena in their incipiency invited the ridicule of the ordinary observer.

Science at the present day commands the respect of the world; nations, looking up to it, seek its advice at all times, and move in no material enterprises without consulting its oracles; yellow-covered literature is beginning to find a rival in well-conducted popular scientific journals and popular treatises on the various branches of science.

As an association of American scientists, we are looked upon as men representing science in all its bearings upon the physical and mental world, and some even go so far as to suppose that we

would arrogate to represent its bearings equally upon the spiritual world. This being the case, it behooves us to guard well our thoughts, words, and acts, else they may do science and ourselves injustice, and misrepresent both Nature and Nature's God.

We are all searchers after truth: but let us be careful that we do not mistake what truth is, and be beguiled into following some fatal error which has simply borrowed the garb of truth, and completely enveloped itself in it, so as to hide its own deformity. Error has often glimmer enough to dazzle the sickly eye of the enthusiast; truth itself shines with sufficient brightness to be seen by the most jealous among scientists.

While it would not be out of place to review the activity of American science for the benefit of the general public, yet it would occupy too much time, and I will merely refer to it to show that our Government is fully alive to the value of well-directed scientific labors. The Government never hesitates to encourage the most thorough investigations by scientific men into all matters that are likely to benefit the people or advance those great scientific investigations which are of a more abstract character. Witness the care and liberality with which it encourages that corps of scientists engaged in the gigantic enterprise of the coast survey in all its various departments; its liberal appropriation of money and means to observe those great astronomical phenomena, such as solar eclipses, the transit of Venus, etc., which, while they may not be attended with any immediate material advantage to the Government, yet serve to instruct our people in those higher and nobler aspirations after great natural truths which must inevitably result in unfolding to us the riches of our land, teeming with every diversified beauty of mountain, valley, and plain, seas, lakes, and rivers, and, beneath her surface, with all the variety of wealth that Nature seems to have been able to produce. While the older portions of the world are making serious calculations, and even looking forward with gloomy forebodings to the time when their soil and rocks will cease to give wealth to toil, our soil and our rocks are but just being turned up to reveal wealth tenfold greater than the world ever knew before. But in the midst of all this abundance let us feel assured of one thing; it is so placed that no sluggard can stretch forth his hand and partake of it.

The wealth of America means toil. And perhaps in this we are even more blessed than we sometimes are disposed to think;

for the rich soil which covers such a vast proportion of our country, some of the states of which, like Illinois, with 55,000 square miles of surface, have hardly a barren acre, yet we can pluck nothing from it; it is not like the tropical forest, from which the indolent natives may gather their food, and live a life of inertia almost akin to that of the beasts that wander through its rich foliage. In this country the arm must be stretched forth, the forest felled, the ground ploughed, provision made against the inclemency of varying seasons, but when this is done what a glorious return! — rich and luxurious crops, abundant harvests. Then, by the numerous navigable streams and favorable surface for roads, a ready market is afforded for the farmer's surplus. And when we go beneath the soil and mine the rock it is not only the uncertain gold and silver, but the sure coal and iron that reward toil, and from the very nature of the labor improve those engaged in it.

As followers and patrons of science we must keep in view the wants and wishes of the people. Sometimes the people themselves, as well as their representatives, are slow to appreciate our labors; but experience has proved that they give way at last to the patient and judicious perseverance of men of science, who in some way or other show that they are not mere abstractionists, but that what they do has practical bearings, and therefore renders the people more powerful both at home and abroad. Science furnishes, so to speak, the raw material out of which all the progress of modern nations is constructed. To use the words of one of our Nestors of science: "It is only in recent times that the value of scientific research began to be felt; and I hope to live, old as I am, long enough to see the community, the enlightened community which has become my second fatherland, appreciate what science is doing for the general prosperity, and then contribute to the necessities of science with that generous liberality which characterizes the acts of American people."

Thus much has been said in reference to science in America, acknowledging our shortcomings and attempting to correct certain erroneous impressions, both in America and abroad, in regard to the labor of scientists in this country. It may appear an attempt on my part to urge undue excuses; such certainly is far from my intention; which is to do simple justice to those prosecuting science under more or less disadvantageous circumstances.

I now pass to the second part of my discourse—the methods of modern science—the caution to be observed in pursuing it, if we do not wish to pervert its end by too confident assertions and deductions.

It is a very common attempt nowadays for scientists to transcend the limits of their legitimate studies, and in doing this they run into speculations apparently the most unphilosophical, wild, and absurd; quitting the true basis of inductive philosophy, and building up the most curious theories on little else than assertion; speculating upon the merest analogy; adopting the curious views of some metaphysicians, like Edward Von Hartmann; striving to work out speculative results by the inductive method of natural science. To me this appears a perversion of Bacon's philosophy, and we cannot wonder that one adopting such views, whatever his claim to genius may be, soon cuts loose from all physical reasoning and becomes involved in the most transcendental and to all appearances absurd opinions, which, however clear to the author, are strange and unintelligible to others; and if at any one time we believe we have caught the conception of the author, this impression is only momentary, and we give up in despair, realizing that we cannot follow his intellectual ecstasies; for, in the language of Tyndall, they are even "unthinkable." Those engaged in such speculations are very commonly found in bitter conflict with each other, forcing on us the belief of the saying of D'Alembert, that "when absurd opinions become inveterate it sometimes becomes necessary to replace them by other errors, if nothing better can be done."

This extreme metaphysical philosophy is referred to for the reason that many scientists, ranking as sober, earnest laborers after truth, are caught dealing in such philosophy in their method of investigation, and sometimes, quite unconsciously to themselves, forgetting that "science is only an accurate record of the processes of nature; that its laws are only generalizations of its observations, and not a declaration of an inherent necessity; and that one of its observations is the uniformity of natural sequence."

I am one of those who believe that everything must give way to the laws of nature; but then we must master these laws, and be sure that we have done this before either interpreting phenomena by them or venturing into the realm of speculation.

As has been already remarked, men are to-day just what they have ever been. As bright intellects and as great philosophers lived two or three thousand years ago as do now; their minds sought out the same great truths that we are searching for in these days, and they sought for them by the lights with which they were surrounded. In those earlier ages poetry, sculpture, architecture, and even some facts belonging to natural history (things that belonged either to the imagination or to the eye), arrived at as high a degree of perfection as perhaps they ever will; for the two senses which appreciate the ideal and the real were as perfect then as now.

But when man was called upon to labor in fields where the imagination and the eye aided him but little or not at all, then the discoveries in these fields and their interpretations call for other means for arriving at results. In modern days we attempt to be guided by the clear light of inductive reasoning which we may think we are employing, when too often it is the very smoky torch of analogy that is being used; and this fact serves to explain why it is that some of the most brilliant philosophers of comparatively modern days are only remembered by their names—as, for example the great French philosopher Descartes, whom Dugald Stewart says "is much better known to the learned of our day by the boldness of his exploded errors than by the profound and important truths contained in his works."

And such an example as this is of great value to the reflective mind, teaching caution, and demonstrating the fact that, while the rules by which we are guided in scientific research are far in advance of those of ancient days, we must not conclude that they are perfect by any means. In our modern method of investigation how many conspicuous examples of deception we have had in pursuing even the best method of investigation! Take, for instance, the science of geology from the time of Werner to the present day. While we always thought we had the true interpretation of the structural phenomena of the globe as we progressed from year to year, yet how vastly different are our interpretations of the present day from what they were in the time of Werner! In chemistry the same thing is true. How clearly were all things explained to the chemist of the last century by the doctrine of Phlogiston which in the present century receives no credence, while chemical phenomena are now viewed in an entirely different light!

Lavoisier, in the latter part of the last century, elucidated the phenomenon of respiration and the production of animal heat by one of the most beautiful of theories, based, to all appearances, upon well observed facts; yet at the present day more delicate observations, and the discovery of the want of balance between the inhaled oxygen and exhaled carbonic acid subverted that beautiful theory, and we are left entirely without one. It is true we have collated a number of facts in regard to respiration, molecular changes in the tissues, etc., all of which are recognized as having something to do with animal heat; still it is acknowledged that we are incapable of giving any concrete expression to the phenomenon of respiration and animal heat as Lavoisier did eighty or ninety years ago.

Electricity is the same now as it has ever been, yet it was once spoken of as a fluid, then as a force, now as an energy readily convertible into caloric or mechanical energy; and in what light it will be considered fifty years hence no one can predict.

Now what I desire to enforce here is that, amid all these changes and revolutions of theories, so called, it is simply man, the interpreter, that has erred, and not Nature; her laws are the same; we simply have not been able to read them correctly, and perhaps never shall be.

What, it may be asked, are we to do then? Must we cease theorizing? Not at all. The lesson to be learned from this is, to be more modest in our generalizations; to generalize as far as our carefully made out facts will permit us, and no farther; to check the imagination and not to let it run riot and shipwreck us upon some metaphysical quicksand.

The fact is, it becomes a question whether there is such a thing as a pure theory in science. No true scientific theory deserves the name that is not based on verified hypotheses; in fact, it is but a concise interpretation of the deductions of scientific facts. Dumas has well said that theories are like crutches, the strength of them to be tested by attempting to walk with them. And I might farther add that very often scientists, who are without sure-footed facts to carry them along, take to these crutches.

It is common to speak of the theory of gravitation, when there is nothing purely hypothetical in connection with the manner in which it is studied; in it we only see a clear generalization of observed laws which govern the mutual attraction of bodies. If at

any time Newton did assume an hypothesis, it was only for the purpose of facilitating his calculations. "Newton's passage from the falling of an apple to the falling of a moon was at the outset a leap of the imagination;" but it was this hypothesis, verified by mathematics, which gave to the so-called theory of gravitation its present status.

In regard to light, we are in the habit of connecting with it a pure hypothesis; viz., the impressions of light being produced by emission from luminous bodies, or by the undulation of an all-pervading attenuated medium; and these hypotheses are to be regarded as probable so long as the phenomena of light are explained by them, and no longer. The failure to explain one single well-observed fact is sufficient to cast doubt upon or subvert any pure hypothesis, as has been the case with the emission theory of light, and may be the fate of the undulatory theory, which, however, up to the present time serves in all cases.

A theory or scientific speculation, to possess any great weight, must receive universal assent by those minds capable of investigating the subject. Thus the undulatory theory of light is universally accepted as representing the true nature of the operation of light, so far as we are now able to interpret its phenomena.

Zoölogists equally learned will agree perfectly as regards the physical structure of an ape and a man, and thus far their results are entitled to universal acceptance; but some of the same zoölogists, by the exercise of the imagination and ingenious analogical reasoning, deduce the man from the ape, while the others cannot see nor recognize any such transformation. In this way both classes present themselves to the curious world, and gather around them supporters; and, like too many cases in our courts of law, the greatest number are convinced not so much by the law or justice of the case, as by the ingenuity and special pleading of the legal advocates.

It is not my object to criticise the speculations of any one or more of the modern scientists who have carried their investigations into the world of the imagination; in fact, it could not be done in a discourse so limited in time as this, and only intended as a prologue to our present meeting. But in order to illustrate this subject of method more fully I will refer to Darwin, whose name has become synonymous with progressive development and

natural selection, which, as we had thought, died out with Lamarck fifty years ago.

In Darwin we have one of those philosophers whose great knowledge of animal and vegetable life is only transcended by his imagination. In fact, he is to be regarded more as a metaphysician with a highly-wrought imagination than as a scientist, although a man having a most wonderful knowledge of the facts of natural history.

In England and America we find scientific men of the profoundest intellects differing completely in regard to his logic, analogies and deductions; in Germany and France the same thing—in the former of these countries some speculators saying that "his theory is our starting-point" and in France many of her best scientific men not ranking the labors of Darwin with those of pure science.

Darwin takes up the law of life and runs it into progressive development. In doing this he seems to me to increase the embarrassment which surrounds us on looking into the mysteries of creation. He is not satisfied to leave the laws of life where he finds them, or to pursue their study by logical and inductive reasoning. His method of reasoning will not allow him to remain at rest; he must be moving onward in his unification of the universe. He started with the lower orders of animals, and brought them through their various stages of progressive development until he supposed he had touched the confines of man; he then seems to have recoiled, and hesitated to pass the boundary which separated man from the lower orders of animals; but he saw that all his previous logic was bad if he stopped there, so man was made from the ape (with which no one can find fault, if the descent be legitimate). This stubborn logic pushes him still farther, and he must find some connecting link with that most remarkable property of the human face called expression; so his ingenuity has given us a very curious and readable treatise on that subject. Yet still another step must be taken in this linking together man and the lower orders of animals; it is in connection with language: and before long it is not unreasonable to expect another production from that most wonderful and ingenious intellect on the connection between the language of man and the brute creation.

Let us see for a moment to what this reasoning from analogy would lead us, if applied to chemical science, which investi-

gates a great variety of compounds that exhibit most curious analogies in all their properties. Take for instance soda and potash — how identical in almost all their properties, and their compounds arraying themselves in identically the same form, defying almost all the senses to detect their difference: if they be brought into relation with other elements, they associate themselves with these elements in identically the same way. The same is true in relation to baryta and strontia, or chlorine, bromine and iodine; the last three elements even show most curious numerical relations in regard to their combining proportions. And then when we pass to the mineral kingdom, what a wonderful property is that isomorphism in the chemistry of Nature's operations!

The chemist, with all these facts before him, has as much right to revel in the imaginary formation of sodium from potassium, or iodine and bromine from chlorine, by a process of development, and call it science, as the naturalist has to revel in many of his wild speculations, or the physicist who studies the stellar space to imagine it permeated by mind as well as light — mind such as has formed the poet, the statesman, or the philosopher.

Yet any chemist who would quit his method of investigation, of marking every foot of his advance by some indelible imprint, and go back to the speculations of Albertus Magnus, Roger Bacon, and other alchemists of former ages, would soon be dropped from the list of chemists and ranked with dreamers and speculators.

To prove the truth of my assertion, that this is the legitimate result of this school of philosophy, I will quote from one of its disciples, F. W. Clarke. He says: "When one is fairly started on a line of thought it is hard to come to an end. If we assume an hypothesis to be true, a hundred others rush in upon the mind and demand consideration. We do not know but that the evolution of one element from another may be possible. The demonstrated unity of force leads us by analogy to expect a similar unity of matter. Those elements which seem to-day so diverse in character may be after all one in essence; at present it can neither be discarded as false nor accepted as true."

What is most remarkable in connection with the above opinion is that the author of it is commenting on matter, in connection with the spectroscope, an instrument whose very triumphs are based on the grand distinguishing lines in the elements of matter,

whether in the earth, sun, stars, or nebulæ, all telling the same dissimilarity and no coalescence.

Is this to be one of the methods of modern science, I would ask? While in our ignorance and short-sightedness we should be careful in pronouncing any assumption as possible or impossible, still there is no reason why these terms should have much or any weight in the study of science; for in the abstract all things in nature are possible, not from any demonstration, but simply because no one can assert an impossibility. What a mass of confusion science would become if we studied its possibilities! for then every conceivable possibility would be entitled to equal consideration. And we are not therefore surprised that the author last quoted should say, "So then we may proceed to theorize in the most barefaced manner, without quitting the legitimate domain of science."

Are we to introduce into science a kind of purgatory into which to place undemonstrable speculations, and keep them there in a state of probation, and say that science cannot discard a theory as false when it cannot be accepted as true? Science, which is preëminently the pursuit of truth, has but one course to pursue: it must either accept or reject what may be thrust upon it.

What I have said is, in my humble opinion, warranted by the departure Darwin and others have made from true science in their purely speculative studies; and neither he nor any other searcher after truth expects to hazard great and startling opinions without at the same time courting and desiring criticism; yet dissension from his views in no way proves him wrong — it only shows how his ideas impress the minds of other men. And just here let me contrast the daring of Darwin with the position assumed by one of the great French naturalists of the present day, Professor Quatrefages, in a recent discourse on the physical character of the human race. In referring to the question of the first origin of man he says distinctly that in his opinion it is one that belongs not to science; these questions are treated by theologians and philosophers: "Neither here nor at the Museum am I, nor do I wish to be, either a theologian or a philosopher. I am simply a man of science; and it is in the name of comparative physiology, of botanical and zoological geography, of geology and palæontology, in the name of the laws which govern man as well as animals and plants, that I have always spoken." And studying man as a

scientist, he goes on to say: "It is established that man has two grand faculties of which we find not even a *trace* among animals. *He alone* has the moral sentiment of good and evil; *he alone* believes in a future existence succeeding this actual life; *he alone* believes in beings superior to himself, that he has never seen, and that are capable of influencing his life for good or evil; in other words, *man alone is endowed with morality and religion.*"

And it may be added that Hartmann, a philosopher of another school, says, selection explains the progress in perfection of an already existing type within its own degrees of organization, but it cannot explain the passage from an inferior degree of organization to a superior one.

If Prof. Quatrefages be right in regard to the moral sentiment in man, then Darwin must be wrong in asserting the development of man out of that in which not a trace exists of what most preëminently constitutes a man; or he must satisfy himself with evolving the physical part of man out of the lower order of animals, and then by some creative force implanting within him these principles.

Our own distinguished naturalist and associate, Prof. Agassiz, reverts to this theory of evolution in the same positive manner, and with such earnestness and warmth as to call forth severe editorial criticisms, by speaking of it as a "mere mine of assertion," and of "the danger of stretching inferences from a few observations to a wide field," and he is called upon to collect "real observations to disprove the evolution hypothesis." I would here remark, in defence of my distinguished friend, that scientific investigation will assume a curious phase when its votaries are required to occupy time in looking up facts, and seriously attempting to disprove any and every hypothesis based upon proof, some of it not even rising to the dignity of circumstantial evidence.

I have dwelt longer on this one point than I had intended; but the very popular manner in which in recent years it has been presented to the public mind of all classes of society, and to persons of all ages, warranted a full notice in speaking of the importance of avoiding, as far as possible, undue speculation in connection with our method of scientific investigation.

Let me not be understood to underrate the brilliant ideas and great learning of those most distinguished men of the nineteenth

century, Darwin, Huxley and others. I am too great a respecter of both science and the pursuit of science ever to encourage by my example anything like dogmatism among scientific men. While arraying methods of study in other branches of science to combat those employed by the followers of the evolution hypothesis, I most willingly indorse what Tyndall says concerning it, viz: "I do not think the evolution hypothesis is to be flouted away contemptuously; I do not think it is to be denounced as wicked. Fear not the evolution hypothesis! it does not solve, it does not profess to solve, the ultimate mystery of the universe. It leaves in fact that mystery untouched." If it be grounded on truth, it will survive all attempts to overthrow it; if based on error, it will disappear, as many so-called scientific facts have done before. Science is a progressive study. It does not dogmatically pronounce itself as infallible; it is at all times ready to admit what has been once rejected, if it return clothed with truthful demonstration which science properly calls for as a passport to admission into its domain.

I would also caution my associates to avoid carefully what may be called the pride of modern science; for so rapid have been the discoveries of science during the last century, crowding upon us especially during the past twenty-five years, that we are apt to become bewildered and dazzled, and cry out in unbounded enthusiasm: Great is the god Science! it revealeth all things to us, and we will consecrate our talent and our time to its worship. The marvellous discoveries in chemistry, geology, electricity, light, etc., have lifted the veil that concealed from us so many of Nature's secrets that we are almost baffled in our attempt to systematize them. The wonderful organic compounds; the disinterring of curious records of past ages; the obedient and submissive lightning that carries our messages; that wonderful light, so quiet in its operations, yet so powerful to reveal the chemistry of the universe; and the conservation of force — all these, I say, bewilder the mind so that we revel in building bright air-castles, almost losing our mental equilibrium. Of all scientists of the present day the chemists perhaps have kept a more stable equilibrium than any other class, starting out with a fixed law to govern them in regard to what are considered elements, never in any instance tolerating the development or transmutation of one element out of another, however remarkable the analogy they may exhibit

in the material constitution of all known substances, and recognizing them as the same whether in the earth or in the sun.

I would, therefore, caution against too great enthusiasm, for we are far more ignorant than we sometimes suppose. In fact, true philosophy dictates to its followers humility, and that it is the province of ignorance to believe that it knows everything, while the philosopher is aware that he knows little or nothing.

While we are prying into space, and studying the matter, size, and movements of the heavenly bodies far beyond our own universe, we leave behind us a vast number of things that have baffled our scrutiny and defied both science and metaphysics. When we look at our bodies, without reference to the consciousness that is within, but merely studying what relates to our physical parts, how many things concerning it we have not discovered!

While occupied, the early part of this year, in reflecting upon the conservation of force and certain meteoric phenomena connected with the sun, my attention was frequently drawn to the small-pox that was then in the form of a violent epidemic around me. Seeing persons being vaccinated who had in their childhood been subjected to the same operation, and observing in the vast majority of cases the failure of the production of any effect, I asked myself the question: How are we to rank that mysterious agent which, when brought to bear upon the system, in however minute a quantity, not only permeates every fibre and cell in every part of the body, but is never lost? for when through years every particle of the body (with perhaps the exception of the teeth and a part of the bones) has been renewed over and over again, yet, as each particle gave place to a new one, this vaccine energy (if I may so call it) was imparted to the new matter, and so on through life. Here then was the conservation of a force as mysterious in its course and operation, and as hard to be understood, as that of motion, light, or any other of the recognized forms of the energies of matter.

Yes! after we have studied the heavens and all contained therein that the aided eye can reach, we shall yet have to descend to earth and study the every-day physical phenomena that are in and around men, finding even greater mysteries to unravel that meet our unaided senses every moment of our existence.

I come now to the last point to which I wish to call the attention of the members of the association in the pursuit of their in-

vestigations, and the speculations to which these give rise in their minds.

Reference has already been made to the tendency of quitting the physical to revel in the metaphysical, which, however, is not peculiar to this age, for it belonged as well to the times of Plato and Aristotle as it does to ours. More special reference will be made here to the proclivity of the present epoch among philosophers and theologians to parade science and religion side by side; talking of reconciling science and religion, as if they had ever been unreconciled. Scientists and theologians may have quarrelled, but never science and religion. At dinners they are toasted in the same breath, and calls made on clergymen to respond, who, for fear of giving offence, or lacking the fire and firmness of St. Paul, utter a vast amount of platitudes about the beauty of science and the truth of religion, trembling in their shoes all the time, fearing that science, falsely so called, may take away their professional calling, instead of uttering in voice of thunder, like the Boanerges of the gospel, that "the world by wisdom knew not God." And it never will. Our religion is made so plain by the light of faith that the wayfaring man, though a fool, cannot err therein.

No, gentlemen; I firmly believe that there is less connection between science and religion than there is between jurisprudence and astronomy, and the sooner this is understood the better it will be for both.

Religion is based upon revelation as given to us in a book, the contents of which are never changed, and of which there have been no revised or corrected editions since it was first given, except so far as man has interpolated; a book more or less perfectly understood by mankind, but clear and unequivocal in all essential points concerning the relation of man to his Creator; a book that affords practical directions, but no theory; a book of facts, and not of arguments; a book that has been damaged more by theologians than by all the pantheists and atheists that have ever lived and turned their invectives against it—and no one source of mischief on the part of theologians is greater than that of admitting the profound mystery of many parts of it, and almost in the next breath attempting some sort of explanation of these mysteries. The book is just what Richard Whately says it is, viz.: "Not the philosophy of the human mind, nor yet the philosophy of

the divine nature in itself, but (that which is properly *religion*) the *relation* and connection of the two beings — what God is to us, what he has done and will do for us, and what we are to be in regard to him."

Now science on her part has her records: they are the discovered truths in the relation that man bears to the animate and inanimate kingdoms around him, so far as they are made out by him from time to time; but as he has to proceed in his labors with imperfect instruments and often equally imperfect senses, he has to correct himself over and over again; and his observations and theories, especially the latter, make frequent shifts, though each time he supposes that the truth has been reached. I will exemplify this in a marked manner by an extract from a recent discourse by Prof. Ferdinand Cohn, delivered before the Silesian Society for Natural Culture. In speaking of Humboldt and his Cosmos (which he styles the "Divina Commedia" of Science, embracing the whole universe in its two spheres, heaven and earth) he says: "But we cannot conceal from ourselves that the Cosmos, *published twenty-five years ago*, is in many of its parts now antiquated. Any one who to-day would attempt to recast the Cosmos must proceed like the Italian architect who took the pillars and blocks of the broken temples of antiquity, added new ones, and rebuilt the whole after a new plan." And I would simply ask: When is this new structure to be torn down to form material for another? Surely the most enthusiastic admirer of the development of the last twenty-five years does not think that we have arrived at the end of all things!

I will take yet another example. For the last fifty years or more the unity of the human race has been a most prolific subject of investigation and discussion, until it was generally conceded that there must have been more than one origin for the different races. In fact, theologians had already entered on that mischievous work called reconciling science and religion, and saying that after all there was some little mistake in the biblical record on that subject, and, if the Author would only permit, it would be well to make a correction just there; but this could not be done, and there it stood — that all men were of one flesh. But science, restless, changeful, moved on; and to-day the unity of the human race is insisted on by nearly all the leading naturalists, who teach what Prof. De Quatrefages teaches, as uttered in a recent lecture

of his. He says: "In this examination of the physical man everything leads to the conclusion which we had already reached in our earlier lecture, and *we can repeat with redoubled certainty* that the differences among human groups are characters of race, and not of species. There exists only one human species, and consequently all men are brothers; all ought to be treated as such, whatever the origin, the blood, the color, the race;" and in conclusion he further says: "I shall not regret either my time or my pains, if I am able, in the *name of science, and that alone,* to render a little more clear and precise for you the great and sacred notion of the brotherhood of man."

One other example under this head, and I have done. The book of science teaches that the sun is the source of all light and heat; yet in that post-prophetic chapter of the book of our religion it is said that the creation of the first day was light, and not until afterward was the sun created; and this was again a stumbling-block to theologians, and many wished that Moses had been a little more particular. But science in its onward march, as it grouped together the matter floating in space to form in the beginning of time this earth (our circling globe), tells us that if we can imagine one to have been placed on our globe before it had consolidated, he would have seen vast seas of vapor floating around and far above it, shutting out the very light of heaven so that darkness brooded over the waters; that the first benign influence that smiled upon the earth was the gentle rays of light struggling through the dark mist; and the prophetic eye, either on the plain, in the valley, or on the highest mountain peak, would not behold whence it came, and might exclaim in sublime poetic ecstasy: "God said, Let there be light; and there was light." Not until ages, perhaps, after that did the bright orb of the sun reveal itself to the prophet as the source of this light.

So I say, let our book of religion stand as it is; if it be not of God it will come to naught; and let science search for truth, and if it mistake its results it is certain to correct them in time, for the causes of its perturbations are as surely discovered as Leverrier and Adams discovered those of Uranus.

Science and religion are both travelling towards the same great point — the Author of all truth — yet by two very different roads; and if they be induced every now and then to turn off their

routes to compare notes, they will very much retard each other's progress and waste much time in discussing the peculiar merits of their particular road, and get into a quarrel about them. The roads they travel are paved with certain principles and forces, but of very different natures.

Science treads on certain mathematical axioms and principles, recognizing matter and certain forces or modifications of an energy innate in matter, as heat, light, electricity, etc. Religion is guided by its axioms and principles, faith, love, and hope, and with these it is expected to work out its great end in the present and future of mankind. Science is nature revealed; religion is Nature's God revealed; and neither the one nor the other can be without its axioms, incapable of demonstration.

Some may mock at faith and say "Faith is bankrupt, and her accounts are under strict examination, to determine what assets remain to be distributed among the impoverished souls that are her creditors;" still it is an axiom made manifest to our consciousness, as much, if not even more so, than the axiom of a mathematical point being something without length, breadth or thickness, or a line as having length without breadth or thickness.

This faith is as much an energy of the immortal, as heat is one of the energies of matter. We know heat by its phenomena alone, and we know faith in the same way, its phenomena proving its existence as well to the child as to the man, to the learned and the unlearned. It led Socrates and Plato, even with their imperfect light, to the great God, the Creator of the heavens and the earth, and to a belief in the immortality of the soul.

What God is in his essence we know not, nor how it is that he can exist. A Being not made by himself nor any one else; without beginning of days or end of years: existing through infinite ages; filling immensity without being in any place; everywhere present without displacing a single one of his myriad creatures; pervading all things yet without motion; being all eye, all ear, all energy, and yet not interfering in the least with the thoughts and actions of man;—this has been well styled "the greatest mystery of the universe, enveloped at once in a flood of light and an abyss of darkness—inexplicable itself, explaining everything else, and after displacing every other difficulty, itself remaining in inapproachable, insurmountable, incomprehensible

grandeur, so that the Psalmist exclaims: 'Clouds and darkness are around about him; righteousness and judgment are the habitation of his throne.'"

This is the God whose existence reason cannot prove, while it cannot disprove, and whom the religionists and scientists are looking for: that they will one day see him as he is, is my firm belief, and, as I before stated, they will see him the sooner by keeping separate roads.

That many a scientist will be swallowed up in pantheism from want of patience is to be expected, and, I regret to acknowledge, will with Hartmann "maintain that creation is a cause, existence a misfortune, life a deepening disappointment, and that the extinction of personal consciousness is the only salvation;" but many more will enjoy the double felicity of arriving at the great end sustained both by science and by religion, and will agree with what Socrates wrote nearly two thousand years ago, without the revealed word of God to enlighten him—or to mystify him, as some would say. Listen to that philosopher of ancient days as he says: "This great God, who has formed the universe and supported the stupendous work whose every part is finished with the utmost goodness and harmony—he who preserves them perpetually in immortal vigor, and causes them to obey him with a never-failing punctuality and a rapidity not to be followed by the imagination—this God makes himself sufficiently visible by the endless wonders of which he is the author, but continues always invisible in himself. Let us not then refuse to believe even what we do not see, and let us supply the defects of our corporeal eyes by using those of the soul; but let us learn to render the just homage of respect and veneration to the divinity whose will it seems to be that we should have no other perception of him than by his benefits vouchsafed to us."

I cannot close this part of my subject without reverting to the tendency of certain men of science to make physical experiment the test of all truth; even prayer and divine providence influencing affairs in this world must become subjects for experiment; and if the results be not in accordance with the experiments, then suspicion is to be cast on faith. This has been truly explained as coming from the spirit of an age which strives to make natural science the all in all of wisdom, and begins with nature instead of beginning with God, and ends with burying man and

even God within physical conditions, and assigning to the supreme Spirit the impersonality that is usually ascribed to material nature; and all this in spite of the fact that profound philosophers and earnest devotees have believed in there being a consciousness subject to influence above their sense.

If we look at Nature as science has thus far penetrated into her mysteries, we discover in the innermost parts of the earth matter in a constantly restless state; in the ocean or the air we behold the ever moving, never resting; above are the sun and stars speeding on through boundless space, and they in their own masses are like huge boiling caldrons casting their vapors hundreds of thousands of miles into space. And so the toiler in science goes penetrating nearer and nearer, as he thinks, to the great cause of all things. In the same way he thinks he has discovered the cause of all motion upon this planet, both in the animate and inanimate, and he hastily concludes that the energy resident in the sun is fixed and invariable; yet while he reasons as if he had arrived at the prime cause, he admits that there is something yet unknown on which the sun depends as much as the earth does upon the sun.

While I admit most freely that the smallest event in the physical world is but the sequence of secondary causes (if I may use the expression) and effects, obedient to what appear to us fixed and invariable laws, yet it is illogical for any mind to assert that they cannot be altered by the operation of some energy that may reach beyond any cause yet discovered by the light of science.

While the *energy of the sun* travels in swift motion and in rapid undulations through the ethereal space that divides the earth from the sun, and in turn science by the spectroscope travels back from the earth to the sun over the same waves, and has revealed to her, in writing as it were, on the beautiful pages of the spectrum, the composition of that incandescent globe and the mighty power of its internal forces, so does the *energy of that great cause* that formed the sun reveal itself to the internal consciousness, reaching the eye of faith, by undulations more rapid than light; and as faith travels back, looking through its spectroscope (the revealed word of God), it beholds the constitution of that great cause as composed of infinite love and mercy, truth and justice.

As light has revealed the sun to us by penetrating an organ

specially formed for its impressions, *the physical eye*, so is God revealed by faith, *the soul's eye*. As well might we say that we are acquainted with all phenomena of the rays of the sun as to arrogate to ourselves the power of limiting the operations of faith.

In these things science is both vain and modest, logical and illogical; as, for example, here is what Dr. Cohn says, in a discourse of his previously referred to: "The deeper natural science penetrates from outward phenomena to universal laws, the more she lays aside her former fear to test the latest fundamental laws of being and becoming, of space and time, of life and spirit:" and in the next breath he says: "It is not to be hoped that during the next twenty-five years all the questions of science which are at present being agitated will be solved. As one veil after another is lifted *we find ourselves behind a still thicker one*, which conceals from our longing eyes the mysterious goddess of whom we are in search."

How Dr. Cohn expects to justify his first statement by his last assertion of the increasing thickness of the impenetrable veil is more than my logic can divine.

But in this matter of subjecting faith to physical test by what is now commonly called the "prayer-gauge," philosophers of the most advanced school differ very widely in their opinion: and that remarkable pantheist (or pessimist), Edward Von Hartmann (probably the most remarkable man of that school since the days of Spinosa, who believing only in nature, yet ranks with the old patriarchs in his idea of the power of faith, or something next akin to it) calls all mankind to "combine together in one grand act of self-abdication, and to resign the very faculty of will by a mighty concert, not of prayer, but of self-renunciation—by the help of such means as art and science may apply, and by such perfection of the magnetic telegraph as shall enable them all at once to will not to will any more, and so to bring all conscious personal life to an end by an absorption in the almighty and unconscious spirit." Not the most ascetic religious devotee could exhibit more unbounded confidence in the power of faith subverting not only the laws of nature, but nature herself, than is expressed in those views.

In fine then, gentlemen, let us stick to science—pure, unadulterated science—and leave to religion things which pertain to it; for

science and religion are like two mighty rivers flowing toward the same ocean, and before reaching it they will meet and mingle their pure streams, and flow together into that vast ocean of truth which encircles the throne of the great Author of all truth, whether pertaining to science or religion.

I will here, in defence of science, assert that there is a greater proportion of its votaries who revere and honor religion in its broadest sense, as understood by the Christian world, than in any other of the learned secular pursuits.

In this address I may be accused of more or less dogmatism: but I can assure the Association that whatever there may be of apparent dogmatism arises entirely from my reluctance to consume more time in making explanations and reasoning fully on the topics discussed. I have moreover departed from the usual character of discourses delivered by the retiring presidents of this association, and have not presented a topic that might have been of more interest to you, viz., some special scientific subject coming more immediately within the province of my research: for this departure I claim your indulgence, as well as for omitting all allusion to scientific progress during the past year.

But before concluding I cannot refrain from referring to one great event in the history of American science during the past year, as it will doubtless mark an epoch in the development of science in this country. I refer to the noble gift of a noble foreigner to encourage the poor but worthy student of pure science in this country.

It is needless for me to insist on the estimation in which Prof. John Tyndall is held amongst us. We know him to be a man whose heart is as large as his head, both contributing to the cause of science. We regard him as one of the ablest physicists of the time, and one of the most *level-headed* philosophers that England has ever produced — a man whose intellect is as symmetrical as the circle, with its every point equidistant from the centre.

We have been the recipients of former endowments from that land which, we thank God, is our mother country, from which we have drawn our language, our liberty, our laws, our literature, our science, and our energy, and without whose wealth our material development would not be what it is at the present day. Count Rumford, the founder of the Royal Society of London, in earlier years endowed a scientific chair in one of our larger uni-

versities, and Smithson transferred his fortune to our shores to promote the diffusion of science.

Now, while these are noble gifts, yet Count Rumford was giving to his own countrymen — for he was an American — and both his and Smithson's were posthumous gifts from men of large fortune. But the one to which I now refer was from a man who ranks not with the wealthy, and he laid his offering upon the altar of science in this country with his own hands; and it has been both consecrated and blest by noble words from his own lips; all of which makes the gift a rich treasure to American science; and I think we can assure him that as the same Anglo Saxon blood flows in our veins as does in his (tempered, it is true, with the Celtic, Teutonic, Latin, etc.), he may expect much from the American student in pure science as the offspring of his gift and his example.

With this feeble tribute to our distinguished scientific collaborator I bid you adieu, and, returning to the association my most heartfelt thanks for the honor that has been conferred on me, surrender the mantle of my office to one most worthy to wear it — Prof. Lovering, of Cambridge.

ON SOME NEW FORMS OF AMERICAN BIRDS.

BY ROBERT RIDGWAY.

The birds described in this article are chiefly geographical forms of well known species, which have not before been characterized. Though we consider them as geographical races, and not as distinct species, they are none the less entitled to separate consideration. According to the usual custom of ornithologists they would be ranked as distinct species; but the laws of geographical, or climatic, variation in external features, with which the public have been familiarized by the writings of Mr. Allen and other contemporary authors, are so evidently the cause of the differentiations noted, that we cannot but consider the forms here described as merely climatic races of species which have like representatives in other geographical provinces.

Included in the paper are some hitherto unpublished descriptions of races of birds by Prof. Baird.

1. *Catherpes Mexicanus*, var. *conspersus* Ridgway. Cañon Wren; White-throated Rock Wren.*

Sp. Char. (No. 53.425 ♂, near Fort Churchill, Nevada, Dec. 7, 1867; R. Ridgway.) Above, brownish-ashy on the anterior, and bright cinnamon-rufous on the posterior half, the two colors shading insensibly together. The anterior, or grayish portion, thickly sprinkled with numerous small circular dots of white, each preceded by a smaller speck of dusky; a few of these dots on the rump. Wings with obsolete, ragged, narrow, *isolated* bars of dusky, these most sharply defined on the tertials. Tail clear rufous, crossed with about nine very narrow, thread-like, somewhat zigzag bars of black,—these about ·02 wide on the middle, and ·07 on the outer feather. Beneath, anterior third, pure silky-white, shading insensibly into soft ochraceous on the breast, this soon darkening into deep ferruginous, the color of all the posterior lower parts; the whole of this ferruginous surface with very obscure transverse spots of white, each preceded by a narrower dusky one. Length, 5·75; extent of wings, 7·50 (fresh); wing, 2·48; tail, 2·13; culmen, ·83; tarsus, ·56. Bill deep slate, paler and with lilaceous tinge at base of lower mandible; iris umber; tarsi and toes black (fresh colors).

Hab. Central region of North America, from boundary of United States northward to the parallel of 40°. Extends up Valley of Colorado. Western Nevada and Utah, resident; Ridgway. Colorado; Aiken; Allen.

The above characters apply to all specimens of *Catherpes* from north of the Mexican boundary, as substantiated by a sufficient series in the collection. It is a remarkable fact that this northern race should be so much smaller than the Mexican one, especially in view of the fact that it is a resident bird in even the most northern parts of its ascertained habitat.

This race may be immediately distinguished from the Mexican form as follows:—

Culmen almost straight, the tip decurved, gonys straight. Above, blackish-brown; wings and back sparsely sprinkled with minute white specks; *no such markings on head or neck*. Bars on tail very broad, ·12 in width on outer feathers. Wing, 2·84; tail, 2·40; culmen, ·96; tarsus, ·75; middle toe, ·68; posterior, ·47; outer, ·52; inner, ·49 (52,791, Mazatlan, Mexico). *Hab.* Mexico . . . . var. MEXICANUS.

Culmen and gonys both gently curved, the latter somewhat concave. Above, cinnamon-ashy, more reddish on rump and wings; head and neck above with numerous dots of white; very few of these on back and wings. Tail-bars very narrow and thread-like, ·07 in width on outer feathers. Wing, 2·48; tail, 2·12; culmen, ·83; tarsus, ·56; middle toe, ·52; posterior, ·35; outer, ·44; inner, ·36 (53,425 ♂, Fort Churchill, Nevada.) *Hab.* Middle Province of United States . . . . var. CONSPERSUS.

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*Troglodytes Mexicanus Heermann, J. A. N. Sc., 2d ser., ii, 1853, 63.—Ib. P. R. R. Rep., x, 1859, 41.—Cassin, Illust. Birds Cal., i, 1854, 173, pl. xxx. Catherpes Mexicanus Baird, Birds N. Am., 1858, 356 (in part); Rev., p. 111 (in part).—Cooper, Orn. Cal, i, 1870, 66. Catherpes Mexicanus, *var.* conspersus Ridgway, Rep. U. S. Geol. Expl., 40th Par. (in press).

In var. *Mexicanus* the white of throat is more abruptly defined against the rufous of abdomen than in var. *conspersus*, in which the transition is very gradual. The latter has the secondaries rufous with narrow isolated bars of black; the former has them blackish, *indented* on lower webs with dark rufous. In *Mexicanus* the feet are very stout, and dark brown; in *conspersus* they are much weaker, and deep black.

All specimens from south of the United States boundary (including Giraud's type of *Certhia albifrons*) belong to the restricted *Mexicanus*.

HABITS.* The geographical distribution of this race of the white-throated wren, so far as known, is confined to the line of the United States and Mexican boundary, extending northward up the valley of the Colorado, as far as western Nevada, and along the Rocky Mountains into Colorado. The corresponding Mexican race reaches some distance southward, but has not yet been detected beyond the limits of Mexico. The habits of both races, however, are quite similar, as far as known.

Dr. Heermann first met with this wren in the spring of 1851, on the Cosumnes River. In the following year he procured three specimens on the Calaveras River. He describes it as an active, sprightly bird, having a loud and pleasing song that may be heard a great distance, and which it repeats at short intervals. When found, it was occupied with searching for insects, between and under the large bowlders of rock that, in some portions of the river, are thrown together in confused masses, as if by some terrific convulsion of nature.

Dr. Kennerly also met with this species in similar localities among the hills bordering upon the Big Sandy, where the rocks are also described as piled up thick and high. They were darting from rock to rock and creeping among the crevices with great activity, constantly repeating their peculiar and singular note. The great rapidity of their motions rendered it difficult to procure a specimen. He did not observe this bird anywhere else.

Their occurrence equally in such wild and desolate regions, and in the midst of crowded cities, indicates that the abundance of their food in either place, and not the absence or presence of man, determines this choice of residence. When first observed they

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*By Dr. T. M. Brewer.

were supposed to nest exclusively in deep and inaccessible crevices of rocks, where they were not likely to be traced. Mr. H. E. Dresser afterwards met with its nest and eggs in western Texas, though he gives no description of either. He found this species rather common near San Antonio, where it remained to breed. One pair frequented a printing office at that place, an old half-ruined building, where their familiar habits made them great favorites with the workmen, who informed him that the previous spring they had built a nest and reared their young in an old wall close by, and that they became very tame. At Dr. Heermann's rancho, on the Medina, he procured the eggs of this bird, as well as those of the Carolina and Bewick's wrens (*Thryothorus Ludoviciana* and *T. Bewickii*), by nailing up cigar-boxes with holes cut in front, wherever these birds were likely to build.

Mr. Sumichrast describes its nest* as very skilfully wrought with spiders' webs, and built in the crevices of old walls, or in the interstices between the tiles under the roofs of the houses. A nest with four eggs, supposed to be those of this species, was obtained in western Texas by Mr. J. H. Clark; it was cup-shaped, not large, and with only a slight depression. The eggs, four in number, were unusually oblong and pointed for eggs of this family, and measured ·80 by ·60 of an inch, with a crystalline-white ground, profusely covered with numerous and large blotches of a reddish or cinnamon brown.

So far as the observations of Mr. Ridgway enabled him to notice this bird, he found it much less common than the *Salpinctes obsoletes*, and inhabiting only the most secluded and rocky recesses of the mountains. Its common note of alarm is described as a peculiarly ringing *dink*. It has a remarkably odd and indescribably singular chant, utterly unlike anything else Mr. Ridgway ever heard. This consists of a series of detached whistles, beginning in a high fine key, every note clear, smooth, and of equal length, each in succession being a degree lower than the preceding one, and only ending when the bottom of the scale is reached. The tone is soft, rich and silvery, resembling somewhat the whistling of the cardinal grosbeak.

It was often seen to fly nearly perpendicularly up the face of a

* This remark applies to the Mexican race.

rocky wall, and was also noticed to cling to the roof of a cave with all the facility of a true creeper.

2. *Helminthophaga celata*, var. *lutescens* RIDGWAY. Pacific Orange-crowned Warbler.*

SP. CHAR. *Male.* Upper surface continuous bright olive-green. Whole lower parts, including superciliary stripe and eyelids, bright yellow, almost gamboge; abdomen somewhat whitish. Inner webs of tail feathers just perceptibly edged with white. Whole crown bright orange-rufous, scarcely concealed. Wing, 2·40; tail, 1·90; bill, ·40; tarsus, ·67; middle toe, ·45. Wing-formula, 2, 3, 1, 4. *Female.* Similar, but orange of crown almost obsolete. Wing, 2·30; tail, 1·90. *Young of the year.* Similar to adult, but with a brownish tinge above; middle and secondary coverts tipped with dull fulvous, furry, inconspicuous bands. No trace of orange on the crown.

HAB. Pacific Province of North America, from Alaska to Cape St. Lucas. Straggling eastward to about the 116th meridian. Not found in Mexico?

The differences between the Pacific coast specimens of *H. celata* and those from the interior regions—first pointed out in the "Review of American Birds"—are very readily appreciable upon a comparison of specimens. The present bird is a coast variety, entirely replacing the true *celata* (var. *celata*) in the region above indicated.

3. *Dendroica Vieillotii*, var. *Bryanti* RIDGWAY. Bryant's Golden Warbler.

SP. CHAR. Similar to D. Vieillotii,† but with the rufous of the head and neck abruptly defined posteriorly, instead of passing backward on the jugulum; the rufous streaks on the breast very narrow, instead of broad and blended; and the outer webs of wing-coverts greenish, nearly concolor with the back, instead of nearly clear yellow, in marked contrast. Wing, 2·70; tail, 2·25; culmen, ·31; tarsus, ·72 (♂).

HAB. Mexico, from Honduras (Dr. BRYANT) and Yucatan (Dr. SCHOTT) to Mazatlan (Col. GRAYSON).

4. *Dendroica Dominica*, var. *albilora* BAIRD. White-browed Warbler.‡

SP. CHAR. Similar to D. Dominica,‡ but with smaller bill, longer wing and tail, and white, instead of yellow, supraloral line. Wing, 2·70; tail, 2·20; culmen, ·35; tarsus, ·60.

HAB. Mexico, south to Guatemala, west to Colima, and east to Yucatan and Honduras. In summer, the Mississippi valley of the U. S., north to Cleveland, Ohio; breeding from southern Illinois southward.

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*Helminthophaga celata Cooper and Suckley, P. R. R., xii, ii, 1859, 178.—Lord, Pr. R. Art. Inst. Woolwich, iv, 1864, 115.—Baird, Rev. Am. Birds, i, 1865, 176 (in part).—Cooper, Orn. Cal., i, 1870, 83. H. celata, *var.* lutescens Ridgway, Report U. S. Geol. Expl. 40th Par. (in press).

†Dendroica Vieillotii Baird, Review, p. 203. (Cassin, P. A. N. S., 1860, 192. Panama.)

‡Dendroica Dominica Baird, Rev. Am. B., 1865, p. 209 (in part).

In the "Review" (p. 209) several variations in this species are noted; but at that time there was not a sufficient number of specimens to warrant our coming to a conclusion as to their value. Now, however, we have better materials before us, and upon the examination of about thirty specimens, including two series of nearly equal numbers,—one from the Atlantic states and the West Indies, the other from the Mississippi region and middle America—find that there are two appreciably different races, to be distinguished from each other by points of constant difference. All birds of the first series have the bill longer than any of the latter, the difference in a majority of the specimens being very considerable; they also have the superciliary stripe bright yellow anteriorly, while among the latter there is never more than a trace of yellow over the lores, and even this minimum amount is discernible only in one or two individuals. The West Indian form is, of course, the true *Dominica*, and to be distinguished as var. *Dominica;* as none of the synonymes of this species were founded upon the Mexican one, however, it will be necessary to propose a new name; accordingly, the term var. *albilora* is selected as being most descriptive of its peculiar features.

The following synopsis, taken from typical specimens, shows the differences between these two races:—

(No. 3,322, ♂, Liberty county, Georgia.) Bill (from nostril), ·45; tarsus, ·60; wing, 2·60; tail, 2·00. Superciliary stripe, anterior to eye, wholly bright yellow; yellow of chin and maxillæ extending to the bill. *Hab.* In summer, Atlantic States of United States, north to Washington. In winter, and possibly all the year, in Cuba, Santo Domingo and Jamaica . . . var. DOMINICA.

(No. 61,136, ♂, Belize, Honduras.) Bill (from nostril), ·35; tarsus, ·60; wing, 2·70; tail, 2·20. Superciliary stripe wholly white; yellow of chin and maxillæ bordered narrowly next the bill with white. *Hab.* In summer, the Mississippi region of United States, north to Lake Erie; common in south Illinois. In winter, and possibly all the year, in Mexico, south to Guatemala, Yucatan on the Atlantic, and Colima on the Pacific side . . . . . . var. ALBILORA.

In the lower Wabash valley this form of the yellow-throated warbler is rather common during summer, and inhabits chiefly the margins of swamps in the bottom-lands, though in spring and fall it makes occasional visits, with other species, to the orchards or even the door-yards within the towns. In its manners it resembles the black and white creeper (*Mniotilta varia*) more than any other species, creeping, not only along the branches of trees, but over the cornice and eaves of buildings, with all the facility of a nuthatch.

5. *Dendroica Graciæ*, var. *decora* RIDGWAY. Honduras Warbler.

SP. CHAR. Similar to D. Graciæ,* but wing and tail much shorter, and general form less slender. The superciliary stripe wholly yellow and scarcely passing the eye, instead of white for from an eighth to nearly a quarter of an inch behind the eye; yellow of throat and jugulum extending over the breast, instead of only reaching to its anterior border; lore deep black, instead of dusky grayish; streaks on the back and crown narrower, and those on the upper tail-coverts broader. Above fine ash, the crown, back and upper tail coverts with shaft-streaks of black; supraloral stripe reaching back to posterior angle of the eye; throat, jugulum and breast, gamboge yellow; rest of lower parts white; wing with two white bands, and inner webs of tail feathers with white patches. Wing, 2·20; tail, 1·95; culmen, ·30; tarsus, ·60.

HAB. Belize, Honduras.

The differences between the three races of *D. Graciæ* may be expressed as follows:—

COMMON CHARACTERS. Auriculars, neck, crown and upper parts generally, ashy; a supraloral stripe; crescent on lower eyelid, and the anterior lower parts gamboge yellow; crissum white.

a. Back and sides streaked with black; abdomen white.

Yellow of throat terminating abruptly at the jugulum; supraloral stripe reaching ·20 of an inch back of the eye, this portion of it white; dorsal streaks broad. Wing, 2·60; tail, 2·20. *Hab.* Arizona (Fort Whipple) . . . . var. GRACIÆ.*

Yellow of throat covering whole jugulum and not ending abruptly; supraloral stripe scarcely passing eye and wholly yellow; dorsal streaks narrow. Wing, 2·20; tail, 1·95. *Hab.* Honduras (Belize) . . . . var. DECORA.

b. Back and sides not streaked with black; abdomen yellow.

Yellow of throat extending back to crissum; supraloral stripe as in var. decora; dorsal streaks wanting. *Hab.* Porto Rico, W. I. . . . . var. ADELAIDÆ.†

6. *Myiodioctes pusillus*, var. *pileolata* (PALLAS).‡

SP. CHAR. Similar to M. pusillus, but much richer yellow, scarcely tinged with olive laterally, and deepened into an almost orange shade on the front and chin. Above much brighter and more yellowish olive-green. The black pileum with a brighter steel-blue gloss. Bill much narrower, light brown above, instead of nearly black. Measures (4.222 ♂, San Francisco, Cal.), wing, 2·15; tail, 2 00.

HAB. Pacific coast region of North America, from Kodiak (Alaska); south through Western Mexico (and Lower California) to Costa Rica.

This is an appreciably different race from that inhabiting the eastern division of the continent; the differences, tested by a large series of specimens, being very constant.

A Costa Rican specimen before us is almost exactly like specimens from California.

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* "Dendroica Graciæ Coues," Baird, Review Am. B., 1865, 210.

† Dendroica Adelaidæ Baird, Review, p. 212.

‡ Motacilla pileolata Pallas, Zoög. Rosso Asiat., i, 1831, 497 (Russian America). Myiodioctes pusillus, var. pileolata Ridgway, Report U. S. Geol. Expl. 40th Par. (in press). Myiodioctes pusillus Auct. (all citations from Pacific coast of North and Middle America).—Lord, Pr. Art. Inst. Woolw., iv, 1864, 115 (Br. Col.).—Dall & Bannister (Alaska).—Cooper, Orn. Cal., i, 1870, 101.

7. *Collurio Ludovicianus*, var. *robustus* BAIRD. White-winged Shrike.*

SP. CHAR. Similar to C. Ludovicianus, but bill much stouter; differs from excubitoroides in darker colors, and absence of hoary border to the forehead; from both in having the four middle tail feathers entirely black to the roots, and the bases of the remaining feathers merely grayish, and in the great amount of white on the inner webs of the secondaries, in the latter respects resembling C. excubitor, of Europe. Length, 8·75; wing, 4·20; tail, 4·40; its graduation, 1·00; culmen, 1·00; depth of bill, ·39; tarsus, 1·20; middle toe, ·61. *Hab.* California?

The above description is taken from a specimen in the collection of the Philadelphia Academy, labelled as having been collected in California by Dr. Gambel, and is very decidedly different from any of the recognized North American species. Of nearly the size of *C. excubitoroides* and *Ludovicianus*, it has a bill even more powerful than that of *C. borealis*. In its unwaved under parts and uniform color of the entire upper surface, except scapulars, it differs from *borealis* and *excubitoroides*, and resembles *Ludovicianus*. In the extension of white over the inner webs of the secondaries it closely resembles *C. excubitor*. The great restriction of white at the base of the tail—the four central feathers being entirely black, and the bases of the others grayish-ashy—is quite peculiar to this form.

The specimen in the Philadelphia Academy we originally referred to the *L. elegans* of Swainson, alleged to have come from the fur countries; as, although some appreciable differences presented themselves, especially in the coloration of the tail, these were considered as resulting from an imperfect description. Messrs. Sharpe and Dresser, however, as here quoted, show that Swainson's type really belongs to *L. lahtora*, an Old World species. We, therefore, find it expedient to give a new name to the variety, having no reason to discredit the alleged locality of the specimen.

Synopsis of the species (including 8, 9, 10 and 11 of this article) of the

GENUS CERTHIOLA SUNDEVALL.†

By SPENCER F. BAIRD.

GEN. CHAR. Bill nearly as long as the head; as high as broad at base, elongated, conical, very acute, and gently decurved from base to tip. Culmen uniformly convex;

*?? Lanius elegans Sw. F. B. A. ii, 1831, 122.—Nuttall. Man. i. 1840, 287.—Cassin, Pr. A. N. Sc., 1857, 213.—Baird. Birds N. Am., 1858, 327. Collyrio elegans Baird, Birds N. Am., 1858, 328. Collurio elegans, Baird, Rev. Am. B., 1864, 444.—Cooper, Orn. Cal., 1870, 140. (According to Dresser & Sharpe, P. Z. S., 1870, 595, who have examined the type, the L. elegans of Swainson is the same as L. lahtora Sykes, of Siberia.) HAB., California?

† Certhiola Sundevall. Vet. Akad. Handl. Stockholm, 1835, 99. (Type, Certhia flaveola Linn.).

gonys concave. No bristles at base of bill. Tail rounded, rather shorter than the wings. Tarsi longer than the middle toe. Iris brown? Nest pensile and arched. Eggs with yellowish ground dotted thickly with rufous spots.

This genus is one of those especially characterizing the West Indies, almost every island as far as known having its peculiar species, differing, it is true, in very slight characters, but always constant to the normal type.* Cuba alone has so far furnished no representative of this genus, its place being supplied apparently by *Cœreba cyanea*, distributed besides throughout the continental tropical regions. The specimens from St. Thomas I cannot distinguish from those of Porto Rico, but this is, so far as the series before me indicates, the only case where one species occurs on two islands. All the West Indian species, nine or ten in number, agree in having the whole upper part nearly uniformly dusky or blackish; the head and back being concolored, while of the three or four South American, all but one (*C. luteola*) have the back more olivaceous, the head much darker. Again, the West Indian species, with a single exception (*C. bananivora*), have both webs of lateral tail feathers broadly and about equally tipped with white; while in all the South American this white is more restricted on the inner web, and on the outer reduced to a narrow border. *C. Caboti* from Cozumel, near eastern coast of Yucatan, exhibits the continental impress in possessing the character last mentioned.

In all the species from the Greater Antilles and the portion of continental America west and directly south of this group, there is a distinct external white patch at base of quills; while this disappears in the species of the Lesser Antilles and eastern South America, or is only faintly traceable. Again, in the species of the Lesser Antilles, with the disappearance of the white wing-patch, the greater and middle wing-coverts show a faint edging of lighter, by which, as well as by the darker back, they are distinguished from their South American allies.

The shape of the white patch at base of the quills on the outer web furnishes, in combination with the color of the throat, excellent and permanent specific characters. This in the Jamaican, Haytien and Bahaman forms is elongated, extending gradually and uniformly behind to the outer edge of the quill, while in those of Porto Rico, St. Thomas, Cozumel, and the South American species, where it exists, the posterior outline is nearly transverse, and only running out a little along the outer web.

As a general rule South American species have shorter tails than the West Indian.

It is a nice question what are really species in this genus, and what merely races or varieties; but it would probably be not far from correct to assume that the various forms described are simply modifications of one primitive species, produced by geographical distribution and external physical conditions. In the following diagnosis I shall treat all the varieties as occupying the same rank, without attempting any discrimination. Although but one of these belongs to the United States, and that as a straggler from the Bahamas, I give the table of the whole, to show the interesting relationship between them.

COMMON CHARACTERS. Above dusky-olive or blackish; the rump olivaceous or yellowish; the head and cheeks always black, and sometimes darker than back. Chin and throat ashy or black. Rest of under part yellow, duller behind. A broad white stripe from bill above eye to nape. A white patch at base of primaries; generally visible externally, sometimes concealed. Lateral tail feathers tipped with white. Bill black; legs dusky.

A. Head uniform in color with rest of upper parts; dark sooty-brown or blackish. Both webs of outer tail feather tipped with white (except in luteola). All West Indian except luteola, which, however, occurs in Tobago and Trinidad, and generally belongs to the shores of the Caribbean Sea.

1. A distinct and conspicuous external white patch at base of primaries. Wing-coverts not margined with paler.

a. Throat uniformly but decided dark ash-color, varying in shade, never entirely black, however, nor ashy-white.

Throat very dark ash, not contrasting or appreciably different from blackish of cheeks.

Wing-spot elongated; the white running out gradually and obliquely behind to the outer edge of the primary, reaching shaft of outer primary. Yellow of breast decidedly ochraceous. Rump as bright yellow as the belly. *Hab.* Jamaica . . . . FLAVEOLA.*

White patch of wing more quadrate on each quill; transverse; not tapering off gradually and uniformly behind; not reaching the shaft on outer primary. Breast without ochraceous; rump olivaceous-yellow; the color different from that of belly. *Hab.* Santa Cruz . . . . NEWTONI.†

b. Chin and throat lighter ash (but not at all whitish); in decided and appreciable contrast with blackish of cheeks. Jugulum yellow, like under parts generally.

Lateral tail feather broadly tipped with white on both webs. Rump olivaceous-yellow.

Wing-spot on each primary nearly quadrate, as in Newtoni. *Hab.* Porto Rico and St. Thomas . . PORTORICENSIS.‡

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*Certhia flaveola Linn. Syst. Nat., ed. 10, 1758, 119.

†C. flaveola A. & E. Newton, Ibis, 1859, 67. *Hab.* St. Croix. C. Newtoni Baird. (8.)

‡C. flaveola, *var.* Portoricensis Bryant, Pr. Bost. Soc. N. H., Jan., 1866. *Hab.* Porto Rico.

Lateral tail feather with inner web only broadly tipped with white. Rump bright yellow like belly. Bill very small.

White of wing as in flaveola, but less extended, and margining edge only of outer primary. *Hab.* Hayti and St. Domingo . . . . BANANIVORA.*

White of wing as in Newtoni. Size much larger; darker above. *Hab.* Tobago, Trinidad, and north shore of South America . . . . LUTEOLA.†

c. Chin, throat and jugulum white, with a tinge of ashy. Yellow of under parts much restricted.

Depth of bill less than half distance from nostril to tip. Superciliary stripe reaching to nape. Yellow of under part restricted to a triangular patch on breast. White spot on wing large, tapering off gradually on each primary, as in flaveola; on the outer reaching shaft. Both webs of outer tail feather about equally tipped. *Hab.* Bahamas and Florida Keys . . BAHAMENSIS.‡

Depth of bill fully half distance from nostril to tip. Superciliary stripe reaching the occiput only. Yellow of under parts more extended. White spot on wing restricted; more quadrate, as in Newtoni; edge only of outer primary involved. Outer web of outer tail feather scarcely tipped. *Hab.* Cozumel Island, Yucatan . . . . CABOTI.§

2. No external white patch at base of primary quills. Wing-coverts obscurely margined with paler. Both webs of outer tail feathers tipped about equally with white. Rump olivaceous; this color of but slight extent.

a. Throat black; continuous with black of cheeks; or else very dark plumbeous, scarcely distinguishable from the cheeks.

Median line of throat white, the sides black like the cheeks; chin alone black. Superciliary stripes not confluent anteriorly. *Hab.* Martinique . . . . MARTINICANA.‖

Whole throat blackish. No white frontal band?

Wing, 2·50 inches. Belly ochraceous. *Hab.* Dominica Island, West Indies . . . . DOMINICANA.¶

Wing, 2·20 inches. Belly more yellow. *Hab.* Barbadoes . . . . BARBADENSIS.**

Whole throat very dark plumbeous. A whitish frontal broad band connecting the superciliary stripes which extend in front of the eye. *Hab.* Antigua, West Indies . . . . FRONTALIS.††

A grayish frontal band; superciliary stripes narrow; not extending in front of eye. Trace of white patch at base of primaries . . . . BARTHOLEMICA.‡‡

B. Head blackish, in distinct contrast to the more olivaceous back. Outer tail feather with outer web scarcely tipped with white. Wing-coverts not margined with paler. Throat light ash, in distinct contrast to black of cheek.

1. A distinct external white wing-patch at base of primaries.

Rump olive-green. *Hab.* Mexico and Central America, but hardly reaching line of Panama R. R. . . MEXICANA.§§

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*Motacilla bananivora Gmelin, Syst. Nat., i, 1788, 951. (Bananiste Buffon, St. Domingo.)

†Certhiola luteola Cab., M. H., 1851, 96. C. major Cab.; C. minor Bon.

‡Certhiola Bahamensis Reich., Handb., i, 1853, 253. C. flaveola Baird, B. N. A.; C. Bairdi Cab.

§C. Caboti Baird, MSS. (9.)

‖C. Martinicana Reich. Hand., i, 1853, 252. C. albigula Bon.

¶C. Dominicana Taylor, Ibis, 1864, 167.

**C. Barbadensis Baird, MSS. (10.)

††C. frontalis Baird, MSS. (11.)

‡‡C. Bartholemica Sundevall & Sparrmann, Vetensk. Akad. Förhandl., 1869, 622.

§§C. Mexicana Sclater, P. Z. S., 1856, 286.

Rump olive-yellow. *Hab.* Panama R. R.; south along Andes to Peru . . . . PERUVIANA.*

a. No external white wing patch.

Rump olive-green. *Hab.* Brazil and Guiana . CHLOROPYGA.†

The preceding table is based upon a critical examination of many hundred specimens belonging to the Smithsonian Institution.

Synopsis of the species of

JUNCO SCLATER.

By ROBT. RIDGWAY.

COMMON CHARACTERS. Prevailing color plumbeous, or grayish, the abdomen crissum and lateral tail feathers white (*J. hyemalis*).

A. Both mandibles light flesh color. Color of the jugulum, deep ash or plumbeous-black, abruptly defined against the pure white of the abdomen.

a. Dark color of the jugulum with its posterior outline convex; sides pinkish.

1. Back and wings more or less tinged with dark rusty. *Hab.* Pacific province of North America, from Sitka southward; straggling eastward in autumn and winter to the Rocky Mountains, and even to Kansas . . . . var. OREGONUS.‡

b. Dark color of the jugulum with its posterior outline concave; sides ashy.

§Back and wings without any rusty tinge.

2. Wing without any white; three outer tail feathers, only, marked with white. Culmen, ·40; depth of bill, ·25; wing, 3·10; tail, 2·80. *Hab.* Eastern province of North America; straggling, in autumn and winter, into the Rocky Mountains (Arizona, COUES; Utah, HENSHAW; Colorado, AIKEN) . . . . . . var. HYEMALIS.§

3. Wing with two white bands across ends of coverts and sometimes a third across ends of secondaries; four or five outer tail feathers marked with white; ash much lighter. Culmen, ·50; depth of bill, ·30; wing, 3·40; tail, 3·20. *Hab.* Alpine regions of Colorado Mountains (El Paso Co., AIKEN) . . . . var. AIKENI.‖

§4. Back (interscapulars only) rufous; scapulars and wings uniform ashy. *Hab.* Central Rocky Mountains of the U. S. . var. CANICEPS.¶

B. Upper mandible black, the lower yellow. Ash of the jugulum fading gradually into the grayish white of the abdomen.

§ Whole back, scapulars, wing-coverts and tertials strongly washed with rufous.

5. Throat and jugulum pale ash; back bright rufous. Wing, 3·10; tail, 3·00; culmen, ·34; depth of bill, ·25; tarsus, ·80. *Hab.* Table-lands of Mexico . . . . var. CINEREUS.**

6. Throat and jugulum deep ash; back dull, or olivaceous, rufous. Wing, 3·15; tail, 3·10; culmen, ·44; depth of bill, ·34; tarsus, ·90. *Hab.* High mountains of Guatemala . . . . var. ALTICOLA.††

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*C. Peruviana Cab., Journ., 1865, 413? Perhaps different.

†C. chloropyga Cab., M. H., 1851, 97. C. Brasiliensis Bp.

‡Birds N. Am., 1858, 466. (Fringilla Oregona Townsend, J. A. N. S., 1837, 188.)

§Birds N. Am., 1858, 468. (Fringilla hyemalis Linn., S. N. i., 1758, 183.)

‖Junco hyemalis, *var.* Aikeni Ridgway, MSS.

¶Birds N. Am., 1858, 468. (Struthus caniceps Woodh., P. A. N. S., 1852, 202).

**Birds N. Am., 1858, 465. (Fringilla cinerea Swains., Syn. Mex. B., i, 1827. 435).

††Junco alticola Salvin, P. Z. S., May, 1863, p. 189.

The six forms diagnosed above appear to be well characterized by the distinctive features pointed out; and each one is so characteristic of the region which it inhabits that at least ninety per cent. of the specimens obtained during the breeding season in any locality will be typical representatives of one or the other of these races. Unless, however, we admit the theory of hybridization, to account for intermediate specimens, and acknowledge it especially in this case, it is impossible to consider that any two of these forms are distinct specifically, for they are connected by an uninterrupted series between the most extreme forms—*hyemalis* and *alticola*—without a break in the gradual progression from the one to the other. Thus, from Sun River, Dakota; Ft. Whipple, Arizona; Ft. Bridger, Wyoming, and the McKenzie River district, are specimens with the pinkish sides of *Oregonus* and plumbeous back of *hyemalis;* or else with black head or rusty back and wings, of the former, with ashy sides of the latter; or with the characters of the two mixed in various degrees. In the same manner other specimens, from Ft. Bridger, Ft. Whipple, Ft. Burgwyn, New Mexico, Colorado, and the Yellowstone region, have the bright rufous interscapulars, ashy head, and black lores of *caniceps* with the pinkish sides and rounded outline to the ash of breast as in *Oregonus;* or else they have the rufous spread over the wings as in *Oregonus*, and other characters as distinguishing *caniceps;* other specimens are intermediate between the two in various ways. This form was characterized by Professor Baird as *Junco annectens* (Birds Cal., i, 1870, app., p. 564). Among the southern Rocky Mountains, and in northern Mexico, specimens are found which combine perfectly the characters of *caniceps* and *cinereus*. These have the black and yellow bill and pale ash throat of the latter, and the rufous of the back strictly confined to the interscapulars as in the former. This form is the *J. dorsalis* of Henry (Proc. Philad. Acad., 1858, 117. Baird, B. N. Am., 1858, 467).

In the effect of climate upon size, altitude appears to have far more potency in this group than latitude; thus in tracing these forms southward, there is no noticeable decrease in dimensions, but on the contrary, the most southern form (*alticola*) is larger than the most northern one (*hyemalis*). The alpine forms, however, *alticola* and *Aikeni*, are considerably larger than those which breed at lower elevations. The climatic color-variation in this

group is rather perplexing, though we can unravel some few clews to the laws. In *Oregonus* of the Pacific coast we find the castaneous or fuliginous plumage characteristic of that region; *caniceps* of the middle region is paler than *Oregonus* and *hyemalis*, as would be expected; in *Aikeni* we readily detect the albinescent plumage of a very cold, alpine region. If we cannot find the same thing in *alticola*, of the alpine summits of Guatemala, and see that instead it is *darker* than the race inhabiting the lower table-lands (*cinereus*), we must look for an explanation. This may, perhaps, be found, in the supposition that the higher summits of Guatemala have a climate sufficiently cool and bracing to invigorate the bird generally, and thus make it larger and stronger, while at the same time the winter temperature is not rigorous enough to produce any blanching effect upon the plumage, while local conditions — perhaps denser forests or thickets — give it a deeper color than *cinereus* of the more open table-lands.

12. *Junco hyemalis*, var. *Aikeni* RIDGWAY. White-winged Snowbird.

SP. CHAR. Generally similar to *J. hyemalis*, but considerably larger, with more robust bill; two white bands on the wing, and three or four, instead of two or three, outer tail feathers entirely white. No. 61,302 ♂, El Paso Co., Colorado, Dec. 11, 1871, C. E. Aiken. Head, neck, jugulum, and entire upper parts clear ash with a bluish tinge; the lores, quills, and tail feathers darker; middle and secondary wing-coverts rather broadly tipped with white, forming two conspicuous bands. Lower part of the breast, abdomen, and crissum pure white, the anterior outline against the ash of the jugulum convex; sides tinged with ash. Three lateral tail feathers entirely white, the third, however, with a narrow streak of dusky on the terminal third of the outer web; the next feather mostly plumbeous, with the basal fourth of the outer web, and the terminal of the inner, along the shaft, white. Wing, 3·40; tail, 3·20; culmen, ·50; depth of bill at base, ·30; tarsus, ·80. HAB. El Paso county, Colorado.

At first sight, this bird appears to be a very distinct species, being larger than any other North American form, and possessing in the white bands on the wing characters entirely peculiar. Its large size, however, we can attribute to its alpine habitat, agreeing in this respect, as compared with *J. hyemalis*, with the *J. alticola*, of Guatemala, which we can only consider an alpine, or somewhat local, form of *J. cinereus*. That the white bands on the wing do not constitute a character sufficiently important to be considered of specific value is suggested by the fact that in *J. oregonus*, and occasionally in *J. hyemalis*, there is sometimes quite a distinct tendency to these bands, in the form of obscure white tips to the coverts.

A series of six specimens (four males and two females), sent for examination, is said by Mr. Aiken to illustrate fully the limit of variation in a series of some twenty or thirty skins. No. 1071 (Aiken's collection) is an extreme example. This has the wing bands ·20 of an inch wide, while the secondaries are broadly tipped with white, forming a third band (somewhat as in *Cyanura cristata*) when the wing is closed; the primaries are conspicuously skirted with white for the terminal half, and the three outer tail feathers on each side are entirely white; only the middle pair is without any white on the webs, and these have the shafts of this color. The other extreme is illustrated in No. 1068, which has the bands on the coverts hardly indicated, while there are none on the inner webs of the secondaries nor outer webs of the primaries. There is nearly as much white on the tail, however, as in No. 1071. Mr. Aiken says that "the majority of the females are without the wing-bands, and they are occasionally wanting in the male."

The largest specimen in the series measures as follows: "length, 7·15; extent, 11·50;" wing, 3·60; tail, 3·50; culmen, ·51; depth of bill, ·27; tarsus, ·85. Few males are smaller and the variation in size is very slight.

HABITS. But little is known as to the habits of this variety; probably they do not differ from those of its congeners. It was met with by Mr. C. E. Aiken, near Fountain, El Paso county, in Colorado Territory, in the winter of 1871–72. They were rare in the early winter, became rather common during the latter part of February and the first of March, and had all disappeared by the first of April. During winter only males were seen, but in the spring, the females were most numerous. They were usually seen singly, or in companies of two or three, and not like the others, in larger flocks.

13. *Peucæa æstivalis*, var. *Arizonæ* RIDGWAY. Arizona Sparrow.*

SP. CHAR. (6,327 ♂, Los Nogales, northern Sonora, June; C. B. Kennerly). Similar to P. æstivalis, but paler; wings and tail longer. Above light chestnut, all the feathers margined and tipped with bluish-gray, but the reddish prevailing. Interscapular and crown feathers with a narrow streak of black, those on crown indistinct. Beneath dull white, tinged with ashy-ochraceous across the breast and along the sides; crissum pale ochraceous. An obsolete light superciliary, and narrow dusky maxillary stripe. Bend of wing yellow; lesser coverts tinged with greenish-yellow. Length 6 inches; wing, 2·65; tail, 3·00; bill, ·32 from nostril, ·25 deep at base; tarsus, ·80; middle toe, ·63. HAB. Los Nogales, Sonora, and southern Arizona.

*Peucæa Cassini Baird, Birds N. Am., 1858, 486. (Los Nogales specimen.)

This race has a considerable resemblance to var. *æstivalis*, but differs in some appreciable points. The brown of the upper parts is paler, and the ashy edging to the feathers appears rather less extensive. The dark brown blotches on the back are of greater extent, the black streaks on the back confined to a mere streak along the shaft. There is less of an olive tinge across the breast.

The proportions of the present race differ more from those of *æstivalis* than do the colors, the bill being more slender, and the wings and tail considerably longer.

The resemblance to *P. Botterii* (=*æstivalis*, var. *Botterii*) of Sclater, from middle Mexico (Orizaba, Colima, etc.), is very close; the difference being greater in the proportions than in the colors, the latter having a shorter wing and tail, with thicker bill, as in var. *æstivalis*. In *Botterii* there is rather a predominance of the black over the rufous in the streaks above.

In the "Birds of North America," the specimen described above was referred to *P. Cassini*, those specimens upon which the latter species was founded being considered as in quite immature plumage. A more recent examination of additional material, however, has compelled us to regard them as representing a perfectly distinct species. In consequence of the similarity of the specimen in question to *æstivalis*, as noted in the article referred to above, the general acceptation of the name *Cassini*, has been that of a term designating a variety of the common species; but we find it necessary to retain under the head of "*Cassini*" only the typical specimens from the Rio Grande region, and refer the supposed aberrant specimen to *æstivalis*. In this Los Nogales specimen we find existing such differences in proportions and colors as are sufficient to warrant our bestowing upon it a new name, and establishing it as the middle province race of *æstivalis*, in this way connecting the south Atlantic and Mexican races (var. *æstivalis* and var. *Botterii*) by a more similar form than the *P. Cassini*, which must be set apart as an independent form,—in all probability a good species. Several facts are favorable to this view. First, we have, of the *P. Cassini*, specimens which are beyond question in perfect adult plumage, and others which are undoubtedly immature; they differ from each other only in such respects as would be expected, and agree substantially in other characters, by which they are distinguished from the different plumages of *æstivalis*. Secondly, the region to be filled by a peculiar race of *æstivalis* is represented by

the var. *Arizonæ*, which is undoubtedly referable to that species; thus we have in one province these two different forms, which therefore are probably distinct.

The *P. Cassini* is hardly less distinct from the races of *æstivalis* than is *ruficeps;* and we should be as willing to consider the latter as a race of *æstivalis*, as to take the same view in regard to *Cassini*.

Synopsis of the genus

CARDINALIS Bonap.

By Robert Ridgway.

Common Characters. *Male.* Bright vermilion-red, more dusky purplish on upper surface; feathers adjoining base of bill black for greater or less extent. *Female.* Above olivaceous, the wings, tail and crest reddish; beneath olivaceous-whitish, slightly tinged on jugulum with red.

C. Virginianus. Culmen nearly straight; commissure with a slight lobe; upper mandible as deep as the lower, perfectly smooth. Bill red. Black patch covering whole throat, its posterior outline convex. *Female.* Lining of wing deep vermilion. Olivaceous-gray above, the wings and tail strongly tinged with red; crest only dull red, without darker shaft-streaks. Beneath wholly light ochraceous. No black around bill.

A. Crest-feathers soft, blended. Rump not lighter red than back.

a. Black of the lores passing broadly across forehead. Crest brownish-red. Bill moderate.

Culmen, ·75; gonys, ·41; depth of bill, ·54. Feathers of dorsal region broadly margined with grayish. Wing, 4·05; tail, 4·50; crest, 1·80. *Hab.* Eastern province of United States, south of 40°. Bermudas . . . . . . var. VIRGINIANUS.

b. Black of the lores scarcely meeting across forehead; crest pure vermilion. Bill robust.

Culmen, ·84; gonys, ·47; depth of bill, ·70. Feathers of dorsal region without grayish borders; red beneath more intense; wing, 3·60; tail, 4·20; crest, 2·00. *Hab.* Eastern Mexico (Mirador; Yucatan; "Honduras") . . var. COCCINEUS.*

Culmen, ·82; gonys, ·47; depth of bill, ·65. Feathers of dorsal region with distinct gray borders; red beneath lighter. Wing, 4·00; tail, 5·00; crest, 2·00. *Hab.* Cape St. Lucas and Colorado basin of the United States; Tres Marias Islands. (Perhaps all of western Mexico, north of the Rio Grande de Santiago) . . . . var. IGNEUS.†

B. Crest feathers stiff, compact. Rump decidedly lighter red than the back.

Culmen, ·75; gonys, ·41; depth of bill, ·57. Dorsal feathers without grayish margins; red as in the last. Wing, 3·40; tail, 3·80; crest, 2·00. *Hab.* Western Mexico; Colima. "Acapulco et Realejo" . . . . var. CARNEUS.‡

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*Cardinalis Virginianus, var. coccineus Ridgway. Am. Jour. Arts & Sci., Dec., 1872.

† Baird. P. A. N. S., Nov., 1859, p. 305.

‡ Cardinalis Virginianus, var. carneus Ridgway, Am. Jour. Arts and Sci. Dec., 1872. ?Cardinalis carneus Less., R Z. 1842, 209.—Bonap., Consp., i. 501. According to the locality quoted ("Acapulco et Realejo") this name is the one to be applied to the variety diagnosed in the synopsis; it is difficult, however, to make anything out of the description, as it is evidently taken from a female or immature bird. If the locality quoted be correct, this form ranges along the Pacific coast southward.

C. Phœniceus.* Culmen much arched; commissure arched; upper mandible not as deep as lower, and with grooves forward from the nostril, parallel with the curve of the culmen. Bill whitish-brown. Black patch restricted to the chin, its posterior outline deeply concave.

Crest feathers stiff and compact. No black above, or on lores; crest pure vermilion; rump light vermilion, much lighter than the back, which is without gray edges to feathers. Culmen, ·75; gonys, ·39; height of bill, ·67; wing, 3·50; tail, 3·90; crest, 2·20. *Female.* Lining of wing buff; above ashy-olivaceous, becoming pure ash on head and neck, except their under side. Crest feathers vermilion with black shafts; no red tinge on wings, and only a slight tinge of it on tail. Fore part of cheeks and middle of throat white: rest of lower part deep ochraceous. Black around bill as in male. *Hab.* Northern South America, Venezuela; New Granada.

ON THE OVIPOSITION OF THE YUCCA MOTH.

BY PROF. CHAS. V. RILEY.

To complete the natural history of *Pronuba yuccasella*, a description of the method of oviposition is necessary. In a former article on this insect occur the following sentences:—

"For want of sufficient time, I have been unable to catch the moth in the act of oviposition; but from careful examination, I am satisfied that the eggs are not deposited on the outside of the fruit. They are either thrust into it from the side or from the stigmatic opening, following, most probably, the course of the pollen tubes. I strongly incline to the latter view, for, though many Lepidoptera are furnished with extensile ovipositors, which enable them to thrust their eggs into crevices and other orifices, I know of none which actually puncture, nor have I been able to discover any trace of punctures leading to eggs.

Neither have I been able to discover the egg *in situ;* which is not to be wondered at, however, as when examined in the female abdomen it is found to be long, narrow, soft and flexible, and of the exact color of the flesh of the young fruit. The ovipositor is so very fine and extensile that it may be thrust into the most minute and narrow passage."

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probably from latitude 20° as far at least as Nicaragua. North of 20°, and on the Tres Marias Islands, it is replaced by var. igneus, and on the Atlantic coast, from Tampico south to Honduras, is represented by the var. coccineus.

In the very long, stiff crest-feathers, and light red rump, this variety of C. Virginianus closely approximates to C. Phœniceus, but in other respects is very distinct.

*Cardinalis Phœniceus (Gould) Bonap. P. Z. S., 1837, p. 111; Consp., i, 501.—Sclater & Salvin, Ex. Orn., Pt. viii, 1868, pl. xliii.

Analogy has proved an unreliable guide in this instance, as, indeed, it often does in natural science; while the curious ♀ *Pronuba* adds one more to the anomalies which belong to her. She *does puncture* the young fruit and convey her eggs into it from its side.

The yucca flowers are fully opened and perfect during a single evening and night only, and it is during this, the first night of blooming, that eggs are consigned to the somewhat prismatic pistil. The pollen grains are not so often expelled, to fall on the inside of the flower, as I had been led to suppose; but almost always remain in an entire lump on the contracted and curled anthers. The moth, consequently, has no difficulty in accumulating her little load of pollen, for a single anther furnishes nearly the requisite amount.

Once equipped with this important commodity, she may be seen either crawling over or resting within the flower. From time to time she makes a sudden start, deftly runs around and among the stamens, and anon takes position with the body between and the legs straddling some two of them—her head turned toward the stigma. As the terminal halves of the stamens are always more or less recurved, she generally has to retreat between two of them until the tip of her abdomen can reach the pistil. As soon as a favorable point is reached—generally just below the middle—the lance-like sheath of the ovipositor, which consists of four converging, corneous bristles, is thrust into the soft tissue, held there a few seconds while the egg is conducted to its destination, and then withdrawn by a series of up and down movements. So intent is she upon this work that after the ovipositor once penetrates the pistil the whole perigon may be detached, some of the encumbering petals and stamens removed, the insect brought within the focus of a good lens and all her movements observed to the greatest advantage, without disturbing her. In this way I have been able to watch the consignment of hundreds of eggs, and to admire the delicacy and elasticity of the ovipositor proper, which issues from the setaceous sheath in a silk-like thread, almost invisible to the naked eye and as long as the terminal abdominal joint; and which stretches and bends according as the body is raised or lowered.

No sooner is the ovipositor withdrawn into the abdomen than the moth runs up to the top of the pistil, uncoils her pollen-bedecked tentacles, thrusts them into the stigmatic opening, and

works her head vigorously as I have previously described — the motion being mostly up and down and lasting several seconds. This carrying of the pollen to the stigma generally follows every act of oviposition, so that where ten or a dozen eggs are consigned to a single pistil, the stigma will be so many times be-pollened. The ends of the tentacles, which are most setose and spiny, and which are always curled into the pollen-mass when not uncoiled, must necessarily carry a number of pollen grains each time pollination takes place; and I have noticed a gradual diminution in the size of the collected mass, corresponding, no doubt, to the work performed, which is indicated by the rubbed and worn appearance of the individual — the freshest specimens always having the largest loads.

While oviposition is generally followed (and not preceded as I formerly supposed) each time by pollination, yet the former sometimes takes place twice, thrice or oftener without the latter being performed; and I suspect that the converse of this is equally true.

Although often marking the exact point at which the puncture was made, it is so very fine and the fruit tissue so soft and succulent that I never succeeded in tracing the passage to the locus of the egg until I dipped the pistil in ink. If carefully done, without bruising the surface or allowing the ink to run in at the stigma, the fruit, by this operation, will be discolored only where the ink has followed the recent puncture, which may then be traced by means of a lens; though by extraordinary practice and manipulation it might doubtless be traced under the microscope, without such aid. The egg is very narrow and elongate, soft, flexile, rather translucent, pointed anteriorly and of the exact color of its surrounding. It lies curved in the ovarian cavity, always on the rounded side next the primary dissepiments (in the cases I have noticed) and with the anterior end for the most part close to the placenta. These facts are best ascertained a day or two after the fruit is plucked, when, in the ink-dipped specimens, a sunken black cicatrice forms around the mouth of the puncture, and the ovarian cavity enlarges by the shrinking of the adjoining tissues. I have little doubt but that the egg increases in bulk before hatching, under the influences of impregnation and endosmosis, and Dr. Engelmann tells me that he has been able to trace the embryo larva under the extremely delicate egg-covering and to observe it curled up at the anterior end of the egg which greatly enlarges.

This larva hatches on the fourth or fifth day after the laying of the egg, and usually commences feeding between two ovules, which, in consequence of its action, swell abnormally. Thus in making a longitudinal section of the fruit these swollen ovules often indicate the presence of the worm where it would otherwise be overlooked while very small.

While oviposition generally takes place in the manner described, the moth head outwards and straddling two stamens, an entirely opposite position must sometimes be assumed, since larvæ and punctures are not unfrequently found in the upper part of the fruit, especially where a single one is stocked with ten or a dozen larvæ, as is sometimes the case.* As the fruit enlarges, the mouth of the puncture forms a slight, discolored depression, more noticeable in some varieties than in others; but the passage-way becomes obliterated.

My observations this summer might be extended much in detail. They have convinced me more than ever that *Pronuba* is the only insect by the aid of which our yuccas can be fully fertilized; for I have studied this fertilization diligently night after night, without seeing any other species go near the stigma. The stigmatic opening closes after the first night and I know of no crepuscular or nocturnal species which could collect the requisite amount of pollen and bring it so to bear on the stigma that each ovule would receive the influence of a pollen grain. The species already enumerated† as frequenting yucca are mostly diurnal and have nothing to do in the work; and wherever I have excluded the moth from the flowers, by enclosing the latter with netting, no fruit has been produced. I am therefore led to believe that the few rare instances of yucca-fertilization, in localities where *Pronuba* may be presumed not to occur, have been brought about by another insect accidentally, or by the stamens reaching an exceptional length, and the anthers being brought into contact with the stigma by the conniving of the closing petals. I have found the stamens of varying length in the flowers on the same panicle and in some instances almost as long as the pistil.

It is my intention to obtain a large number of cocoons this year and it will give me pleasure to distribute them among those who

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* I have counted as many as twenty-one larvæ in a single capsule of what is apparently *Y. flaccida*.

† Trans. St. Lou's Ac. Sc., iii. No. 1, p. 59.

grow the yucca in those parts of this country or in Europe where seed is not produced. The cocoons will be best sent in early spring and should be buried three or four inches beneath the soil at the foot of the plant.

REVIEWS AND BOOK NOTICES.

PREHISTORIC RACES OF THE UNITED STATES.*—Had the so-called Indian never existed in North America, it would, we think, have been a more satisfactory undertaking to endeavor to solve, from existing data, the mystery of that forgotten people of this continent, now known as "Mound-builders." Careful as one may be, it is impossible to avoid uniting the traces of the two people, especially when describing stone implements, while professedly treating of but one of these races. Even among the many relics of the redman found in the Atlantic states, there are frequently gathered single specimens, that seem applicable to the mound-builder rather than to the Indian; so, judging from relics of this character only, there seems to be a closer tie between the two peoples than the learned author of the volume before us is disposed to admit. Such is the impression made by a careful perusal of that portion of the work which describes the stone implements found in and near the earthworks referable to the mound-builders; and it is the copper weapons and pottery that distinguish this people, studied only by the smaller relics that are found; for no stone implement occurs in the mounds, or is otherwise assignable to the mound-builders, that is not also characteristic of Indian "finds." When, on the other hand, we familiarize ourselves with the wonderful mounds, for temple sites, for sacrifice and sepulture, and with the long lines of an enclosure for defence and other purposes, then indeed, we see abundant reason for drawing the lines between the people who erected them and the ruder redmen; and admitting that "a broad chasm is to be spanned before we can link the mound-builders to the North American Indians."

* Prehistoric Races of the United States of America. By the late J. W. Foster, LL.D. Chicago, S. C. Griggs and Co. 8vo, cloth. pp. 415. Illustrated.

In the opening chapters of the book, Dr. Foster gives an admirable résumé of the evidences, in Europe and in the United States, of the antiquity of man; and follows these chapters with others on the geographical distribution of the works of the mound-builders; shell-banks (which are as referable to Indians as to mound-builders); the construction of the mounds; the arts and manufactures of their builders, and also, on their copper-mining operations at Lake Superior.

Succeeding these, is an exceedingly interesting chapter on the crania of the mound-builders, and then, after discussing manners and customs as the basis of ethnic relations, the author asks in chapter x, "Who were the mound-builders?"

We have not the space to enter into a detailed analysis of the several chapters, briefly noticed above, although embracing so many subjects that are of steadily increasing interest to American archæologists. As the main object of the work, however, is to solve the deep mystery of the origin and fate of the mound-builders, it is well that Dr. Foster's own reply to these questions should be given. He writes, with reference to the first of these, "Instead of seeking to establish ethnic relations between the mound-builders and any of the races of the Old World, founded on the apparent similarity of manners and customs, I would look rather for their origin to that race who, in times far remote, flourished in Brazil, some of whose crania are found in the bone-caves of Minas Geræs, in connection with mammalian bones belonging to genera and species now extinct."

With reference to their fate, while occupants of the territory where their earthworks now are found, he remarks: "The distinctive character of the mound-builders' structures, and also the traditions which have been preserved, would indicate that this people were expelled from the Mississippi valley by a fierce and barbarous race, and that they found refuge in the more genial climate of Central America, where they developed those germs of civilization, originally planted in their northern homes, into a perfection which has elicited the admiration of every modern explorer."

We have here two very clearly expressed ideas as to the origin of the mound-builders in North America, and of their departure therefrom. Dr. Foster does not believe, as we have seen, in an *extra*-American origin of this people; but seeks it rather in the

discovery, by Dr. Lund, in Brazil, "of human bones of both sexes entirely preserved and partially petrified; in fact, truly fossil bones, mixed with those of gigantic and extinct animals,*" "and points out the similarity of the crania from Brazil with authentic mound-builders' skulls, that similarity being "a remarkable deficiency of the frontal eminences, amounting to an almost entire absence of the forehead," and further adds, "a type which we find delineated on the monuments of Mexico and Central America and which is seen in the crania recovered from the shores of Lake Michigan and the banks of the Wabash and Mississippi."

These mound-builders' skulls, it appears, from Dr. Foster's researches, "differ on the one hand from the Indian type, which is brachycephalic, and from the Teutonic, on the other, which is dolicocephalic. They are intermediate, or orthocephalic;" and, after giving some craniological details, adds, "I think we are justified in drawing the conclusion that the mound-builders were not the ancestors of North American Indians."

The conclusion drawn being that orthocephalic mound-builders could not or did not degenerate into redmen, who according to Retzius are brachycephalic, "on that side of our continent which looks towards Asia and the isles of the Pacific" and dolicocephalic along the Atlantic seaboard, being nearly related to the Guanches of the Canary Islands, and the Caribs—but that "the primeval people of Brazil, the Huanchas of Peru, the platform builders of Mexico and the mound-builders of the Mississippi Valley" were closely allied people. Of these, however, Dr. Foster distinctly states that the latter are orthocephalic; while Retzius describes the others as decidedly dolicocephalic. If therefore both authors are correct, we cannot trace the connection between the mound-builders, as described by Dr. Foster, and the races described by Retzius, to whom our author refers so frequently, as to the characteristics of their crania. And, on the other hand, if the orthocephali are derived from dolicocephalic autochthones of Brazil, why may not their descendants have become, by sexual selection, brachycephalic redmen, or indeed reverted to the ancestral dolicocephalic form? The fossil men of Minas Geræs may be the ancestors of the mound-builders, but do the craniological details brought forward by Dr. Foster, of themselves prove it?

*Journ. Anthrop. Inst. London: Vol. II, p. 408.

A word more, and we have done. We have asserted that our author did not seek, out of America, for the origin of the American races. Such would seem to be his opinion, when he asks the question (chap. x) "Who were the mound-builders?" and also in discussing "manners and customs as the basis of ethnic relations:" but in chapter xi, we find Dr. Foster asserting that he doubts not "that there will be found continuous and uninterrupted causes which shall explain all the diversities in the different branches of the human family, without the necessity of resorting to independent creations." To this we cannot subscribe, and think we see in it a contradiction to the whole tenor of the preceding chapters.

The antiquity of the redman in America can scarcely be measured; it is probable that he "witnessed the declining existence of the mastodon and megalonyx, in the later ages of the glacial period*"—that of the mound-builder can scarcely be greater, and efforts to trace his origin "to a common fountain of life, as with other races now inhabiting the earth, soon involve the investigator in the mazes of conjecture."

We learn from the preface of the volume before us, that Dr. Foster hoped at a later day "to draw more liberally from the materials at his command." It will ever be a source of regret that his untimely death has forever ended his valuable labors in American archæology. Valuable and interesting as is the work we have briefly reviewed, we doubt not but that a more comprehensive monograph from the same gifted source would have overcome many of the difficulties that now beset the path of American archæologists.—C. C. A.

Classification of North American Beetles.†—Since his recent return from a stay of several years in Europe, Dr. LeConte has applied himself to the study of our beetles, and with what success may be seen in the amount of work contained in the two pamphlets we notice in this number of the Naturalist.

Though this second part is much smaller than the first, and treats of but two families, the Spondylidæ and Cerambycidæ, yet the work is done in the same thorough, comprehensive way that

* Dr. Jos. Leidy, in Indigenous Races of the Earth, p. xviii.

† Classification of the Coleoptera of North America. Prepared for the Smithsonian Institution by John L. LeConte, M. D. Part ii. Washington, May–June, 1873. 8vo. pp. 69.

characterized the first, and which places the author, in his masterly grasp of the subject, foremost among the living writers on Coleoptera.

Each family of beetles is fully characterized, with detailed descriptions of the subfamilies, tribes, and brief diagnoses of all the genera, together with interesting remarks of a general nature. The work when completed will necessarily be a complement as well as supplement of Lacordaire's famous "Genera of Coleoptera," and will invite the attention of European entomologists, while in America it will be the Coleopterist's *vade mecum.*

New North American Beetles.*—Dr. LeConte, in this second part of "New Species of North American Coleoptera," describes eighty-nine new species of beetles, mostly from the Pacific coast. A number of new genera are also characterized.

BOTANY.

Flowering of Aplectrum.—With us the flowering of *Aplectrum hyemale* Nutt. appears to be an exceedingly rare event; so much so, that close watching of the plant in our woods, for several years, on my part, has been unrewarded by a single instance of its blossoming. The experience of others corroborates the conclusion that it is a shy bloomer, at least in Michigan. I am anxious for information on the point referred to, as regards other localities. A friend once succeeded in obtaining the flowers by taking up the plants in the spring, and keeping them in saucers of the rich black mould which the Aplectrum loves so well, thoroughly moistened. A plant which I once potted sent up a fine scape, several inches high, but, owing to the want of proper care during my absence from home, it did not come to perfection.

The Aplectrum was formerly well represented in the woods north of Detroit; but the encroachment of the city is fast destroying the station which was remarkable for the abundance of this rather scarce plant. However, it is, even now, far from exhausted. On the 20th of April, 1873, I took from a space about ten feet square, in a piece of beech woods, thirty of these plants, which I

*New Species of North American Coleoptera. Prepared for the Smithsonian Institution by John L. LeConte, M.D. Part ii. (Smithsonian Miscellaneous Collections (264), Washington, May–June, 1873. 8vo. pp. 71.

transferred to my garden, in the hope of seeing them blossom. I shall duly communicate the result. Some years ago, I gave several handsome roots to a Boston friend, for cultivation; but I have not heard since regarding them. Some which I have kept potted for three years invariably send up every summer their large, many-plaited leaves, which remain throughout the winter as usual; but the flowers are not produced. It may be that, in order to procure the desired result, the pot should not be kept housed during winter, but remain plunged in the open ground.

I have thought that perhaps the destruction of the native forest, depriving the plant of some element necessary to its perfect development, is the cause of its so seldom or never blossoming here. This is a suggestion worthy of note as regards the history of other plants as well as of this one. Of late years the Aplectrum is, with us, of less luxuriant growth than formerly.—HENRY GILLMAN, *Detroit, Michigan.*

A YEW FLOWERING IN WINTER.—About six weeks ago I nipped a small spray off a dwarf yew tree, protruding through the snow, in my neighbor's garden. It was my intention to press it; but for immediate convenience it was put in a glass of water, in the sitting room, and for some time no more was thought about it. A few days ago (Feb. 7), I was astonished to find a number of full blown flowers on the spray. These pretty, diminutive objects were accompanied with an interesting phenomenon. The anthers kept up a little fusillade of explosions, throwing off the yellow pollen in tiny clouds. My thumb nail, which happened to be near one of the little globular catkins about as large as a canary's eye, was quite yellow with the ejected powder. I shook off some on the slide of a microscope. They were, in form, when under a lens of high power, like angular pebbles, and although I had barely touched the slide with my nail, yet the number of pollen grains under the microscope was innumerable. To me, this affair was intensely interesting, and a very pleasant episode in a sick room. The entire process can doubtless be repeated by any one, with the certainty of success, even in midwinter. The pretty little strangers still continue blooming on my table, and impart a cheeriness to this unusually bleak St. Valentine's Day.—S. L., *in Monmouth Democrat, Freehold, N. J.*

Variations in Medeola and Uvularia.—On the 17th of June, 1872, I found in the woods near Fredericton, N. B., a specimen of *Medeola Virginica* (not rare in these parts), possessing the following unusual characteristics.

The whole plant was about eighteen inches high. Instead of the usual whorl of leaves near the middle of the stem, the whole of these were clustered at the summit, there producing a sort of double whorl, of twelve leaves in all, the lower and outer being of the usual size and gradually becoming smaller and oval-lanceolate towards the top, thus embracing the upper whorl of three leaves usually found beneath the flower. The latter was still more anomalous in character, the *single* blossom (which was *erect*, and not recurved, upon a short stout peduncle) having one petal recurved between two of the sepals, which with the remaining petals were alike and spreading, with incurved edges. Within the perianth were four other bodies, apparently petals, but somewhat stamen-like in aspect, followed by three good and three apparently abortive stamens, the whole surrounding *six* dark purple stigmas! Are these results the effect of an effort at reversion, or are they due to a partial consolidation of the two or more flowers usually found in the same situation — or both?

Another curiosity, though less remarkable than the last, and recently observed by me, is a specimen of *Uvularia sessilifolia* possessing *three* well formed flowers instead of the solitary one or rarely two, described in Gray's Manual as usual with the plant. Both of the above specimens were preserved and are now in my herbarium.—L. W. Bailey.

A New Ballast Waif. — Kaighn's Point, opposite Philadelphia — a place where ballast is discharged — is noted for the foreign plants which appear there year after year, some of which are disposed to remain. To the list of such plants which has been published we may now add a remarkable one, *Calycera balsamitifolia*, a native of Buenos Ayres, a representative of a singular small family, nearly allied to *Compositæ*, and peculiar to extra-tropical South America. It was collected by Mr. Isaac Burk, and determined by Dr. H. Leffmann of Philadelphia.—A. G.

ZOOLOGY.

The Preservation of the Lower Animals.—I have the honor of making known to the class two methods that I have employed at Helgoland, during the last season, for the preparation and preservation of Medusæ, Ctenophoræ, Noctilucæ and most of those lower forms, transparent as crystal, which live at the surface of the sea, and which the use of the towing net furnishes in abundance. I submit to the class different Medusæ (Oceania, Geryonopsis), Ctenophoræ and some Noctilucæ prepared for several months, and remarkable for their perfect preservation.

One of these methods consists in the use of a weak solution of osmic acid, the other in the use of picric acid.

Osmic acid has been constantly employed in histology, especially for the study of the nerve-terminations, and Max Schultze has made known, by his beautiful researches on the structure of the retina, all the advantages which the use of this reagent presents. Not only does the osmic acid harden the most delicate tissues and organs, allowing us to make fine sections, but it possesses the valuable property of coloring brown, afterwards black, the fatty parts in general, and more particularly myeline. It tints in brown epithelial cells and muscular tissues; it renders very apparent the fibrillar structure of the cylinder of the axis of nervous fibres, and brings out clearly the isolated nerve fibrillæ. Very recently, F. S. Schultz has employed with great success osmic acid for his beautiful histological researches on *Cordylophora lacustris*. This reagent indicates admirably the limits of the cells and brings out well their different characters.

I have used osmic acid to prepare Medusæ and Ctenophoræ, in order to save them from the destructive action of alcohol, in the following manner. The object is placed in a very feeble solution of osmic acid, for a time varying, according to the nature of these minute organisms, from fifteen to twenty-five minutes. After this lapse of time the animals are colored pale brown; the cells of the endoderm and the organs attached to the endodermic layer are alone colored, and the other tissues preserve their original transparence. Thanks to this coloration of the endodermic cellules the gastro-vascular canals are admirably indicated, and the cirrhi become more distinct than in the small, living Medusæ. At the same time all the

tissues harden, and we can then withdraw from the acid solution the objects which have been submitted to its action, wash them carefully several times, and then place them in strong alcohol without running the risk of finally destroying either their elegant forms or the transparence of their tissues. We can even after several weeks, and probably after several months, study the organization and the structure of these delicate beings as well as if we had them living under our eyes.

Another method that I have employed with success consists in the use of picric acid in a concentrated aqueous solution. I have preserved in this liquid, for about six weeks, small Medusæ (Oceania) and Noctilucæ. We only notice that the small Medusæ, which are perfectly transparent in life, have become plainly opaque. I have examined microscopically some Noctilucæ thus preserved, and can state that they appear just as they came from the sea.—E. VAN BENEDEN.

THE AVI-FAUNA OF COLORADO.—Dr. Coues, in the June number of the NATURALIST, criticises the Holden-Aiken list of the Birds of Colorado. So far as his criticism has any pertinence, it would seem to be to complain of the incongruity of grouping in the same list birds found in northern and in southern portions of this territory. If this were the first time that local lists were made, based on political and disregarding natural lines, it would perhaps be worth while to discuss this point. Or I might fall back upon my reserved rights, and, while allowing to my critic the full right to his individual opinion, claim the right to differ, *toto cœlo*. Or I might cite, in extenuation of my offence, a well known list of New England Birds, in which "such birds as" the hooded warbler and the Canada jay "find themselves in ornithological company they never saw outside of a book—" or that of the birds of Arizona, or of South Carolina wherein similar forced associations are only possible *cum longo intervallo*. But my transgression is one for which I propose to make no excuse, and for which I do not need even such illustrious examples; and I would not now have referred to this critique but for an unfortunate error which I deem it important to set right. Facts are more valuable than mere unsupported theory, and illustrations are peculiarly unfortunate when they contradict instead of confirming an hypothesis. Such is the case with my critic. To demonstrate the impropriety of the

Holden-Aiken list, Dr. Coues says "such birds as *Geococcyx Californianus* and *Pipilo mesoleucus* find themselves in ornithological company they never saw outside of a book." Now so far from demonstrating the incongruity of this list, the sentence I quote proves the need of it. It enables us to teach even so good an ornithologist as our critic, and it also shows that it is never safe to argue on merely negative ground. The illustration he has chosen, so far from confirming, refutes his objections. Mr. Aiken informs me that not only are both of these birds found in Colorado, even in the same county, but that he knows positively of several instances in which *G. Californianus* and *P. mesoleucus* have been seen within a few rods of each other. A valid reason might also be urged for the absence, in the list, of any description of *Junco Aikeni*, but it would not interest your readers to hear it: enough that it was both unavoidable in itself, and a postponement rather than an omission.—T. M. Brewer.

Malformations.—Last winter one of our pupils at New Brunswick, N. J., communicated the fact that he had purchased, the previous autumn, of a huckster woman in Newark, a pair of young ducks, each having four wings. The woman had twelve for sale, and said that the eggs were laid by a well formed bird; that she hatched a brood of sixteen, every one of them having four wings. The youth said that his birds used both pairs of wings in flying, that is, in moving rapidly on the surface of the pond. They did not live long. Whether this was due to any defective vitality in the birds, or to any extraneous cause, could not be learned.

But we turn from these traditionary facts to a catastrophe, which our own eyes have inspected, as having befallen a family of cats.

About a mile and a half from Freehold, N. J., lives an intelligent family who have had for several years an annual litter of malformed cats. Several years ago a young male cat was brought from Allentown, some twenty miles distant. This cat had a deformity in one front foot, which had six toes. It coupled with a cat of normal form and parts, and a litter of four or five was the result, all with six-toed front feet. The she cat became troublesome, getting into the pantry, and so was sent off. The kittens were disposed of except one. With this the paternal cat united, and the result was four kittens each having six toes on each forefoot, and five on each hind-foot. This intermixing, as I under-

stand, by this Grimalkin Turk, has gone on for some four years, and to-day, July 29th, I examined one of his daughters, some three months old, which has *six toes* on each of the hind-feet, and *seven toes* on each of the fore-feet. The fore-feet are bifurcated; that is, they have, as it were, each two paws to one foot, the outer paw of each foot being much the larger, and having four toes; and the inner, or smaller paw, on each foot, having three toes. This kitten was one of a litter of four, all malformed precisely alike. On some points I could not get the exact information desired. But I should think that the vitality of these cats is becoming less and less, as they do not become common. To me it seems astounding when I attempt to conceive of the physical equation which enters into this erratic conception — the minuteness of the abnormal material which, plus the normal substance as imparted by the spermatozoön, gives the initial impulse to a result so eccentric. If, as Goethe declared, "It is in her monstrosities that Nature reveals to us her secrets," one would like to know something of the mode and motive of such a distribution of the life force. During our inspection of Miss Tabbie it was all very well so long as we stroked her back with one hand. She purred as expressive of true feline luxuriousness; and, what is not common, she even licked the other hand as indicating affection. But when we meddled with her extremities, she evidently regarded it as taking personal liberties with unpleasant peculiarities; and instantly rewarded our duplicity by investing in our hand the seven talons concealed in that duplex napkin.—SAMUEL LOCKWOOD.

THE "WILLOW WANDS" FROM BURRARD'S INLET.— I have been able definitely to place the above, referred to by my friend "W. H. D.," on page 488 of this volume of the NATURALIST, by the receipt in this city of several specimens in good preservation. The "wands" or "switches" prove to be what the majority of scientific gentlemen who had seen specimens, supposed, viz., the central stalks or axes of Alcyonoid polypes, but do not belong to the genus *Umbellularia* as suggested by me, but to a new species of *Pavonaria*, which I have described in the "Mining and Scientific Press" (August 9th) of this city, under the name of *Pavonaria Blakei*. It is a beautiful form resembling in a general way the British species *P. quadrangularis* from Oban. The most perfect specimen, but not the largest, displayed some 245 Λ-like rows,

and numbered about 5000 individual polypes. With *P. Blakei* were received specimens of *Pennatula tenua* Gabb, described in Proc. Cal. Acad., vol. ii.—R. E. C. Stearns, *San Francisco.*

The Kingfisher.—In a recent number of the Naturalist is a note by Dr. Abbott contradicting Darwin's statements as to the manner in which the kingfisher (*Ceryle alcyon*) takes its food. Permit me to add my testimony in favor of Darwin. Having observed the habits of birds for some years I can say that the kingfisher divides its food by means of its bill, before swallowing. The smaller fish being soft are easily crushed and divided while being swallowed. The larger fish are frequently partially swallowed and so carried to a convenient perch and there disgorged, and then a few strokes of the bill divide it ready for digestion. A dissection of a kingfisher will show the above to be the case.—E. E. Breed, *Duluth, Minn.*

The "Horned Toad."—It may be of some interest to the readers of the Naturalist to know that the common horned toad (*Phrynosoma cornuta*) produces a large number of young at a single birth. Last summer Mr. George Eddy of this city brought me a toad which had given birth to twenty-five little ones, and two weeks ago (July 14) a boy called after me and showed me a toad which only two hours before had given birth to twenty-seven. The young were exceedingly active and could run as rapidly as the old one.—John Wherrell, *Leavenworth, Kansas.*

The Black Snowbird Breeds on the Graylock Range.—I have for some time suspected that the black snowbird (*Junco hyemalis*) breeds on the mountains of this region; but I have never found the nest of this bird here till to-day. To-day I found the nest, with two eggs, on one of the hills belonging to the Graylock range. It was on the ground just under the edge of a little bank and was made of dried grasses and lined with black hair.

Jacob Horton, of the senior class in this college, found the nest and eggs of this bird on Graylock a few days ago.—Sanborn Tenney, *Williams College*, Aug. 6, 1873.

Addition to the Avi-fauna of America.—One of the birds obtained by our party in the Aleutian Islands during last season, with an incomplete set of eggs, was forwarded by Prof. Baird (to whom the specimens were submitted) to Mr. Harting of London;

it is the *Tringa crassirostris* of Temminck and Schlegel, a species hitherto known only from eastern China and Japan, and an interesting addition to our northwestern fauna.—W. H. Dall.

GEOLOGY.

On a Few Mineral Localities which are Not Mentioned in the Books.—Beryl occurs sparingly in the southern part of Sullivan, New Hampshire. I have an absolutely perfect crystal, both terminations perfect, from this place. Dana mentions beryl from Sullivan with a query.

From Alstead, N. H., I have obtained crystals of beryl which have yielded the most beautiful gems. The beryl here is found near the well known mica quarry. In the mica quarry itself there occurs an interesting variety of albite, containing prominent scales of a silvery colored mica. The small crystals of beryl from the old mica quarry are remarkable for their modified terminations.

In Gilsum, N. H., I have obtained crystals of beryl, and fine crystals of mica. I found them in a cut made through the coarse granite, for the highway, between Gilsum and Marlow.

A mile or two northwesterly from the centre of the town of Acworth, N. H., and on the north side of the old highway from this town to North Charlestown, there is a locality of blue kyanite, an account of which, however, I gave at the Troy meeting of the American Association for the Advancement of Science. The kyanite will be seen, by the careful observer, on the stone wall by the wayside, and it is found in place a little to the northward of the wall. A variety of kyanite (fibrolite?) is common in the mica slate of the eastern part of Marlow, N. H. Black tourmaline also occurs in this town.

Plumbago occurs sparingly in the last named town; also more abundantly in Weare, N. H. The fact of its occurrence in Weare may have been recorded before. I am not sure about it.

Acicular crystals of rutile in perfectly limpid quartz occur as bowlders in the southern part of New Hampshire. I have one of these which I obtained in Jaffrey, N. H., but of its exact locality I am not now sure. I may here add that I have a similar specimen from the northern part of Vermont, and from the fact that not a few specimens of this sort have been found in these two states, it is evident that somewhere to the northward there is an important locality of this mineral.—Sanborn Tenney.

THE "GLADES" OF MARYLAND.—Will you call the attention of geologists who may be passing over the Baltimore and Ohio railroad to this very peculiar region? From a bird's-eye view which I had from a summit, a little north of Oakland station, in Alleghany county, I am satisfied that these meadows were the seat of ancient glaciers. If this is so, it brings the former glacier level of the Alleghanies much lower than has heretofore been supposed; that is to say down to 2400 or 2500 feet above mid-tide at Baltimore. — GEORGE GIBBS, *New Haven*.

BOWLDERS.—I believe it has long been known that in many cases bowlders are formed by exfoliation and disintegration in the very situations in which we find them. Fine examples of granite bowlders of this sort occur near the ordinary stage road about five or six miles, more or less, north of the Yosemite.—SANBORN TENNEY.

ANTHROPOLOGY.

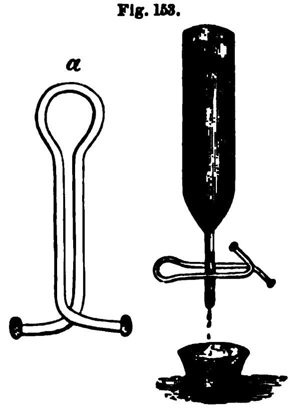
THE AGE OF THE FAMOUS GAUDELOUPE SKELETON.—M. Hamy has just made, at the Museum of Natural History at Paris, a discovery of much interest in relation to the age of the famous Gaudeloupe skeleton. He found in one of the blocks containing a skeleton of a child eight years old, an amulet of jade, representing a batrachian. This jewel he pronounces to be of Carib origin. Rochefort and Du Tertre speak of the fondness of the primitive inhabitants of this archipelago for certain green and red stones, and especially those which had the form "grenouille" (frog). The block was carried to Paris at the same time as the one enclosing the skeleton examined by Cuvier. *Abridged from the Paris "Journal des Débats."*

MICROSCOPY.

A NEW CHIMNEY FOR MICROSCOPE LAMPS.—Mr. Wenham uses as a chimney a cylindrical brass tube with a space cut out of one side, which space is closed with an ordinary glass slide held in place by a spring clip. The tube is not liable to accident, and the perishable part, the glass slip, can be instantly replaced wherever the microscopist may be, while the peculiarly shaped glass chimneys, commonly used on microscope lamps, cannot be obtained away from the large cities.

Separating Diatoms.—In cleaning diatoms, and in preparing other microscopic specimens, it is often necessary to decant part of the fluid in a vessel without disturbing the remainder, in order to separate those objects or particles which are heavy and settle promptly from those which are lighter and remain longer diffused through the liquid. When no great nicety is required, the upper portion of the liquid may simply be poured carefully off from the lower; as in washing sediments, where all but the heavier part is to be thrown away. A much better separation is accomplished by a syphon, either the upper or the lower portion, preferably the latter, being quietly drawn off by this means. This apparatus is so simple as to be easily made and managed, and easily cleaned for subsequent use. Of the more complicated contrivances for this use, one of the best is Benning's (See Nave's Collector's Hand Book of Algæ, etc., London, 1869, p. 26), which consists of a tall jar with a series of stop-cocks or taps at various heights, the water containing the objects being conducted by a funnel to the bottom of the jar, and the objects escaping with the water from the various taps according to the readiness with which they settle through the water. Another plan, a modification by John H. Martin of a previously used apparatus (see Martin's Manual of Microscopic Mounting, London, 1872, p. 24), consists of a closed cylinder with several tubes leading through the top, the lower ends of these tubes opening inside of the cylinder at different heights, and the fluid being forced out through them by the pressure of a column of water carried in a flexible rubber tube. The disadvantages of these contrivances are their complexity, difficulty of cleaning, and danger of imperfect cleaning. A simpler arrangement is to use a tube drawn out to a funnel-shape at the bottom, and closed below by a spring-tap consisting of a rubber tube pressed together by a wire spring as represented in the cut. This apparatus, described in the "Collector's Hand Book" (p. 22) and elsewhere, is easily worked and cleaned, and eminently satisfactory. Though much used abroad, it has scarcely been adopted in this country.

Fig. 153.



Spring Tap.

NOTE ON A NEW $\frac{1}{75}$ OBJECTIVE.—In the NATURALIST for August appears the announcement that "Mr. Tolles has recently completed a $\frac{1}{75}$ objective perfectly satisfactory to himself." Now the fact is Mr. T. never constructed an objective of any power "perfectly satisfactory to himself," and I really think it necessary to put in a plea in abatement to this effect.—ROBT. B. TOLLES.

WALES.—Wm. Wales, who has been abroad this summer, has returned to Fort Lee, N. J., and resumed work in the construction of his well-known and much-used objectives.

NOTES.

AT the second meeting of the Agassiz Natural History Club, held at the Anderson School of Natural History, July 30th, Mr. Jordan gave an account of two algæ common on our shores, known as *Chordaria flagelliformis* and *Dictyosiphon feniculæcus*, which have been considered as distinct plants and referred to different orders. Areschoug suggested, some time ago, that the latter was but an abnormal state of the former, but this view has not been accepted by other algologists. Mr. Jordan showed a drawing of a specimen of Chordaria found in Penikese harbor, two of whose branches were, to all appearances, Dictyosiphon, both to the naked eye and under the microscope. Unless the Dictyosiphon were parasitic, which on close examination seems impossible, or unless it be not identical with the plant described under that name in Europe he thought we must conclude that the two alleged species are but different forms of *Chordaria flagelliformis*.

Mr. Ingersoll mentioned some of the changes in the general forms of terns, in their growth. In the bird just ready to hatch the head is about as bulky as the whole body, and the distance from the commissure to the crown is nearly as far as to the occiput; the bill is short and thick, the eyes well forward, large and closed. The shoulders are tolerably narrow and the body widens and thickens posteriorly. The legs are long in proportion, lack color and rigidity, and seem fat and useless. The body is covered with flexible, hair-like tubes instead of feathers, which, however, indicate in their areas of growth the pterylography of the species. At birth changes begin which culminate in maturity. The bill becomes long, attenuated and sharp at the tip, until it measures from commissure to tip twice the distance from commissure to

occiput. The bill is now bright red with more or less black about the tip. The black tip is apparent in the embryo, but the red does not appear till the bird is ready to fly, and then but faintly. Meanwhile the top of the head flattens till the angle between it and the culmen is almost lost; so that the longest diameter of the head is the horizontal. The neck is still long and slender, but in the body the main bulk is anterior between the shoulders, and not in the hinder part of the body where the yolk is absorbed, as in young birds. The breast bone gradually increases in strength and the keel assumes its large proportions by the time of maturity.

Mr. J. Tingley asked if the colors could be preserved in starfishes. Prof. Agassiz replied that certain shades of color were more evanescent than others, but in the end all would disappear. Specimens preserved in glycerine or alcohol would preserve their colors for a short time. It was not known to what the colors were due; and this was true of all marine animals. Color, in some fishes examined, was found to be due to different oils accumulated in distinct cells, and different tints arose from the grouping of certain cells. The Professor said further that nothing could be more beautiful under the microscope than these pigment cells, and it was easy to obtain them — only take a little piece of colored skin. He had forty folio colored plates of one species from the embryo, where the pigment cells were few, up to older specimens where they were crowded one behind the other, and he had seen them in very many conditions, yet he had not come to the end of the story. The different tints were, he supposed, owing to different oxidation; at any rate the colors seemed to be different conditions of an identical substance.

At the recent meeting of the American Association for the Advancement of Science held in Portland, Maine, from Wednesday, August 20th to Tuesday, the 26th, one hundred and fifty-seven papers were entered on the general list. Abstracts were received of all but nine and were referred to the sectional committees who allowed most of them to be read; a number that were read, however, were not approved by the committees for publication. This careful discrimination is yearly becoming more necessary in order to keep up the character of the papers accepted for publication and to keep the limits of the volume within the means of the Asso-

ciation, though it would be a subject for great regret if funds were not at hand for the printing of every paper that advanced science.

The very opportune donation of one thousand dollars by Mrs. Elizabeth Thompson, the first patron of the Association, will allow the commencement of a new series of publications of papers embodying original research, thus enabling the committee to show especial honor to such papers. Seventy-seven of the papers presented were referred to Section B (natural history) and many of them were of first rank in scientific importance.

The general character of the meeting was decidedly scientific, and the discussions, though sometimes sharp, were carried on with a general good feeling and no personalities arose to mar the good nature of the meeting. The rooms of the City Building, where all the meetings were held, were all that could be desired. The Local Secretary and a few other members of the Local Committee were indefatigable in their efforts to make the meeting pleasant and successful so far as the local arrangements were concerned. It must be confessed, however, that the social element and the sympathy of the citizens generally with the objects of the Association were far less than at any previous meeting which we have attended. The lunch given by the ladies of Portland and the clam bake at Old Orchard Beach broke the ice a little, but that hearty entering of the citizens into the objects of the Association, which has characterized former meetings, was wanting. The excursions, by rail and steamer, after the adjournment, were much enjoyed by those able to remain and take part in them. About two hundred old members were present and one hundred and ten new members were elected. Prof. Lovering in his closing remarks as president made an eloquent speech and declared the twenty-second meeting closed at 11 o'clock A. M. on Tuesday, August 26th.

Among the important business transacted during the session was the report of a special committee on a revision of the Constitution, looking to a better carrying out of the objects of the Association. This report will come up for action at the next meeting which will be held at Hartford, Connecticut, on the second Wednesday of August, 1874.

The general officers of the next meeting are Dr. J. L. LeCont President; Prof. C. S. Lyman, Vice President; Dr. A. C. Hamli General Secretary; Mr. F. W. Putnam, Permanent Secretary.

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THE STRUCTURE AND GROWTH OF DOMESTICATED ANIMALS.*

BY PROF. LOUIS AGASSIZ.

THE subject announced in the programme for this evening's lecture is "The Structure and Growth of Domesticated Animals." It would take a year's course to do justice to the whole subject, and I had therefore to choose a portion of it, and especially such a part as may give you an idea of the difficulties of investigating some of the topics which are, perhaps, of the greatest importance in practical life. It is often expected that science will furnish all the information wanted at a given moment, but unfortunately science is not always ready. My object is to show that you must have knowledge before you can apply it, and that knowledge is not always to be had for the asking. There is not always that information on hand which may be needed even for the most useful purposes; and in order to allay the impatience which is sometimes manifested in respect to the want of usefulness on the part of scientific men and their ability to enter into the arena of practical life, I wish to show you how difficult it is to handle some of the subjects, and I have chosen one respecting which, of course, a farming community supposes that science can furnish all the information wanted.

* Delivered before the State Board of Agriculture at Barre, December 3d, 1872. From the Twentieth Annual Report of the Secretary of the Massachusetts Board of Agriculture. We are indebted to C. L. Flint, Esq., Secretary of the Board, for the use of the accompanying illustrations.

Concerning the anatomy of our domesticated animals there is a great deal known; enough to give a good idea of the peculiarities of the full-grown animals of the different kinds which we raise to use for various purposes. Concerning the functions of their organs, there is also a great deal known, which is of value and service to guide us in our treatment of them. Nobody expects to treat a pig as he treats a horse; and the difference in our management of two such animals is determined by what we know of their structure, by what we know of the functions or the play of their characteristic organs; but there is one topic about which the farmer would like to know more, and that is in reference to breeding; and especially such points in the process of breeding as would enable him to do certain things which would add greatly to the value of our stock. If it were known how to raise male animals in places where it is desirable to have them in larger numbers, if it were known how to raise heifers in those regions where dairy farming is largely carried on, imagine what an advantage it would be to be able to determine beforehand the sex of the animals to be bred. Unfortunately, we do not know enough to-day to guide us in that direction, and yet I have not the remotest doubt that the time is coming when we shall be able to bring forth what we want, as we have been able to produce certain peculiar modifications of the various kinds of domesticated animals to suit our purposes,—when we want beef rather than milk, when we want strength rather than delicacy of structure. Now, how shall we get at it? We have not the information. You may consult the men of science, the most learned men of the day in every part of the world, and they will say, "Upon these topics we have no satisfactory knowledge whatsoever." It is to be reached only by studying the various functions connected with the process of breeding, by studying especially the earlier stages of the growth of animals with which we are familiar, and studying them with reference to that point. Upon that topic I will make a few statements concerning the facts with which I am familiar.

It is not long since all animals were divided into two classes with reference to their breeding. Some were called oviparous—that is, egg-laying animals, which multiply by laying eggs, out of which a young animal is eventually evolved; the others were called viviparous,—such as bring forth living young, after a more or less protracted gestation; and these two classes of animals were sup-

posed to be widely different one from another, both in structure and in mode of reproduction; but less than fifty years ago, a German physiologist, Karl Ernst von Baer, one of the ablest investigators of our century, made the astounding discovery that all animals bring forth eggs that may not be distinguished from one another at a certain stage; that all our cattle, all our domesticated animals, all the beasts of the forest, as well as all the birds on earth, produce eggs similar to one another. This seems a very extraordinary statement, yet perhaps I shall be able to make you familiar with the fact, and to make you understand it as fully as you know that your hens lay eggs. But the eggs of a great many animals most useful to us, and of those about which we would like to know most, have not been studied microscopically. I have devoted a great deal of my life to similar topics, and I have never yet seen the egg of a mare; I have never yet seen the egg of a cow; I have never yet seen the egg of a pig; yet I believe that these animals bring forth eggs as much as the animals that have been investigated with reference to that point. A sufficient number of quadrupeds have been studied to leave no doubt that all quadrupeds produce eggs as well as birds, as well as all other animals, without exception. One of the ablest physiologists of our time, Professor Bischoff, of Munich, has devoted over twenty years of his life to the study of a few of these animals, and the results of his investigations are embodied in a volume of many hundreds of pages, with a large number of plates, representing the history of only four species of quadrupeds. One is the rabbit, another is the dog, a third is the guinea-pig, and the fourth a species of deer which is common in the forests of Europe,—the roebuck; and the history of these animals, as presented in this volume, covers only the very earliest period of gestation,—and mainly that portion of their history embraced during the first days of gestation, during the time when the egg of these animals is transformed into a germ which grows to be an animal like the parent. Now, unless we can have a similar history of any one of our more valuable domesticated animals, as of the horse, or of the cow, we cannot expect to know how to influence their reproduction. This is the very foundation of all knowledge in that direction. What will be necessary for that? When these investigations began they were made upon animals which could be secured at the lowest price; they were begun with the hen. Two

young German physiologists, Pander and D'Alton, under the guidance of Professor Döllinger, began that study, and, in order to ascertain how the chick is formed,—not how the chick grows in the egg, but how it is formed during the first hours after the sitting of the hen upon the egg has begun,—they opened three thousand eggs. Now, why is it that we have not yet such knowledge of the horse? Because there are not three thousand mares to be sacrificed to study their development; and unless some means are found by which something of the kind can be done, we cannot have the beginning of the history of that one animal; unless, perhaps, with the greater knowledge we now possess and long acquired skill, a smaller number of individuals may suffice; but not until hundreds and hundreds of animals are sacrificed for that purpose, under proper conditions, can we have the first fact concerning their history. And if you find in physiological text-books this subject treated as if it were entirely known, it is simply because the data in reference to the animals, the physiology of which is given in our text-books, are borrowed from the four animals carefully studied by Bischoff, and not from any particular knowledge obtained from the domesticated animals themselves. When, in our human physiology the embryology of the human race is presented, it is largely illustrated by conditions which have been studied from the rabbit, the dog, the guinea-pig and the roebuck. Direct observations are so few that they are hardly worth mentioning. A few cases of suicide have furnished the only information which is on record concerning the first condition of the human being.

And now I propose to show you what an egg is, and then to satisfy you that all animals produce such parts as deserve the name of egg.

A hen's egg, surrounded by its shell, which is calcareous, is lined on the interior by a double membrane. A skin extends over the whole internal surface, and that skin is double; and in one part of the shell it recedes from the shell and leaves an ope space, which is the air-chamber of the egg. These are only pr tections of the egg, and are formed last upon it. In the interi of the egg we have a round ball of yolk which is suspended in t egg by two cords of somewhat harder albumen than that wh surrounds the yolk. These two cords keep the yolk so suspen in the egg that whatever position you give the egg, certain p

always remain uppermost. You may open any number of eggs and you will always find that a little white speck stares you in the face. You may turn the egg as you please, but that little speck will always be uppermost. This is owing to the fact that the yolk is heavier in one portion and lighter in another and that it may swing upon the two strings of albumen by which it is suspended. This speck, called blastoderm by embryologists, is the part from which the young chick is developed when the egg is brought under proper conditions of temperature, etc.

As to the albumen, or white, it is not one mass; it consists of a number of layers; and when you boil an egg so that the whole is hardened, it is easy to see that it peels off in these layers, which are deposited one after another. Now such an egg has a history. It does not begin to be an egg of that size; it does not begin with having a shell; it does not begin with having these membranes within the shell; it does not begin with having the white around the yolk. There is a time when the egg has neither shell, nor these membranes, nor the white, but when the whole egg is yolk; and you may find such eggs in the organ called the ovary, in which the eggs are produced. If we look carefully at the ovary of the hen, we find that it contains a variety of eggs. It has eggs which have attained to their full size—they are about the size of a small walnut—it may contain a certain number of these—but by the side of these large yolks there are smaller yolks of various dimensions, and if you will examine minutely, you will soon see that there are those, which, at the distance of a few feet, you could not see at all, even if I represented them magnified a great many times; and you gradually, by learning to watch more and more closely, detect among this mass of eggs which are readily visible, others which are less and less distinct to the eye; and if you take a magnifying glass, you find that there are others which had escaped your eye when you had no magnifying power to help you; and, if you use higher and higher power, you begin to find that there are more of these most minute eggs, which loom up to your eye in proportion as you use a higher power of the microscope. It is like the starry heavens, where you have stars of first, second, fourth and tenth magnitude, some of which are visible to the naked eye, and others only through the telescopes of our observatories. Yet all these small specks in the ovary, invisible to the naked eye, are *bona fide* eggs. As soon

as one of the full-grown yolks drops, to be taken up by the fallopian tubes and carried through the oviduct, there to be surrounded by albumen, and then by a shell,—another grows larger, and when all those which are at any moment of full size have been laid, they are followed by another crop, and crop after crop comes to the surface of the organ, ready to be laid in succession. If you watch their growth, it is easy to see that each one passes into the condition of the eggs higher in size by a process of increase which is similar to the process by which a young animal grows to acquire the dimensions of an adult. Nobody now doubts that these small granules scattered through the ovary are really eggs in their incipient condition.

How do they look when examined under the microscope,—say under a microscope magnifying two hundred and fifty times the diameter,—an egg, therefore, which could not be seen by any human eye? You magnify it, as I have said, two hundred and fifty times, and you will see that that egg is a sphere, which you may, with the microscope, magnify to look as large as a full-grown yolk. It is then perfectly transparent, as if it were full of a uniform fluid, like water; but at some places on the side it has a little vesicle, a little bag, which is also transparent, and may only be seen under skilful management; in this again there is still another microscopic body which appears like a small dot. Now you examine an egg a little larger than that, and you will perceive that in it the fluid mass is obscured slightly by small dots. If you apply the highest powers of the microscope to these dots, you very soon find that they are not solid granules, but that they are hollow vesicles which, in their turn, produce other granules within themselves, so that the growth of an egg is in fact the enlargement of little granule-like masses of animal substance, which are transformed into bag-like bodies within which the same process is repeated over and over again. As the whole egg grows larger, these little granules burst and scatter their contents into the surrounding fluid; and the egg, from perfectly white, becomes slightly tinged with yellow, and finally grows more and more opaque; and, when the yolk has acquired its full size and is ready to drop, it is really an opaque mass, but consisting throughout of these minute granules.

Now let us take the ovary of the rabbit, the guinea-pig, or any other quadruped, and examine its contents, and we see eggs ex-

actly like these young eggs of the hen; so similar to them, that the most skilful observer is incapable of distinguishing the one from the other,—the egg of a rabbit from that of a hen. Of course they do not remain in that condition. There is this peculiarity: that the egg of a quadruped remains small, and while retaining these small dimensions undergoes of itself changes by which the germ is developed in time: while, on the contrary, the egg of a bird grows large; even before it has its shell, its yolk becomes very large, and it is surrounded by those auxiliary means of protection necessary for an egg which is to be cast before the germ is formed; while the fecundated eggs of mammalia are not cast, and the young undergo their development in the egg while the latter is still retained by the parent. And so it has been proved by Baer, that there is no difference whatsoever between so-called viviparous and oviparous animals, but that all produce eggs which have the same identical structure, and which differ from one another only by their various capacities, by the various proportions which they attain, and by the various ways in which the germ is developed in them.

One more word to satisfy you that this is the case in all animals. Eggs of the larger birds have been observed as I have said, and it needs not to be repeated that in every species in which the observation has been carried on, it has been found that the ovarian egg,—that is, the egg prior to its being laid,—has the small dimensions and the peculiar structure characteristic of all ovarian eggs in their earliest condition. This is also the case with reptiles. Our little turtles lay eggs of considerable dimensions in comparison with their size; but examine their ovary, and you will find that there are contained in that organ eggs of all possible dimensions, as in the bird, and that when young these eggs do not differ from the egg of the quadruped. And so it is with the fish, whatever be the kind of fish. I have examined many sharks and skates, as well as many of our salmon and trout and our various kinds of suckers and codfish, and I know that all these different kinds of fish produce similar ovarian eggs. Some of them lay them early, and lay eggs which are at once recognized as eggs, and others retain their eggs until the young are fully developed and they bring forth then, like the quadruped, living young; so that they exhibit within the limits of one and the same class differences sim[illegible] [illegible]e which we observe among

different classes in the higher animals. And if we pass from the class of fishes to the lower types of the animal kingdom,—to insects, for instance, crustacea, and worms,—we find everywhere the same process. Even the parasitic intestinal worms are now known to be produced by eggs, and eggs which are transferred by various processes from one animal to another, sometimes with their food or drink, at other times by boring into the body of their host, thus remaining parasites in succeeding generations. The same thing has been observed among the various kinds of mollusks,—the cuttlefish and periwinkles, the oysters, mussels, etc., for all these produce eggs; and when the eggs are examined, at the proper time, and in a proper manner, they exhibit exactly the same structure as those of the higher classes; and we may go down to the very lowest classes of the animal kingdom—the seaurchins, the starfish, the jellyfish, or even the corals or polypes, and there again eggs are found, and eggs which in no way differ from those of the higher animals.

From such statements, which cover now such extensive ground, it might be inferred that to know one is equal to knowing all. By no means; for enough has already been done to show us that every one has its peculiarities, every one has its own mode of development, and in every one there are peculiar processes which make the generalization only true in the most comprehensive form of expression, and no longer true in the details of the farther development. So that all our knowledge of the process of reproduction in one species of animals may not give us an answer when we would inquire into the corresponding process in another animal. Thus you see the necessity of repeating for those animals, the breeding of which we would desire to influence, all those observations which have been made upon a few.

I should like presently to make some remarks as to the kind of training necessary for this, that you may not imagine that the first enthusiast can go to work and do it. It requires a long training to be prepared to look at an egg, to be prepared to see how it grows; but before I make any such remarks, I would say a few words more concerning the formation of the germ, so that you may see what an interesting field of observation is now open to the student; *open*, not yet *cultivated;* by no means cultivated to the extent desirable in order to make the knowledge in any way useful in practical life. There is that condition necessary to

all knowledge, that it should be acquired, not only in its general features, in order to be useful, but that it should be brought to a point where it shall be really applicable to any practical purpose; and a great deal of the difficulty in scientific investigation arises from the fact, that while it is easy to study, to a certain extent, it is not always easy to carry our knowledge to the point where its application becomes easy or even practicable. And I would say, to exonerate science from its failure to make itself more generally popular and practical, that the mental qualities required for investigation are not the same as the qualities required for practical application. You know too much of practical life to need to be told that the importers who bring to your manufacturing establishments the raw materials are not those who make the cloth for your clothes; or that those who import the raw materials with which all the various manufactures are produced are not likely to be themselves manufacturers; and the ability of the one excludes very often the ability of the other. In scientific matters this is perhaps more extensively the case than in practical pursuits, so that a class of men must be educated who will take up knowledge where the scientific man leaves it, and carry it where the man of business, or the practical man, requires it. I could mention many a case in which scientific men have injured themselves in their attempts to derive profits from their scientific work or to apply their knowledge to practical purposes. That will happen again and again when scientific men rashly enter the arena of practical life. You must allow them to work in the field for which they were prepared, and accept from them what they can give. I claim that as due to science, and I think the sooner the community understands it the sooner will all have the benefit of what science can produce, and cease to ask the impossible from scientific men.

In this first presentation of the subject of embryology I shall not be able to give the whole history of the formation of a new being, but only so much of it as will satisfy you that our higher animals produce eggs like birds and the lower classes; but with this essential difference, that in mammalia the fecundated egg is not cast or laid, but undergoes all its changes within the maternal body until the living young is dropped. Here are several figures of ovarian eggs of the dog, rabbit and human female, which may easily be compared with the eggs seen in the ovary of a hen. Figures 154, 155, 156, 157, 158, 159, 160 and 161 are such ovarian eggs.

Figures 154, 155, 156, 157, 158, 159 and 160 show that the eggs of different mammalia, such as rabbits and dogs, resemble one another as much as the eggs of different species of birds belonging to different orders of this class.

The formation of a germ in the egg begins by a very peculiar process, called "segmentation." It is unquestionably a manifestation of the internal life of the egg,—for an egg must be

Fig. 154.

Ovarian egg of dog. Copied from Bischoff's embryology of the dog. Magnified 100 diameters.

Fig. 155.

Another ovarian egg of dog, from a female in heat. Copied from Bischoff. Magnified 100 times.

Fig. 156.

Ovarian egg of dog, freed of the cells which surround the zona pellucida in figs. 154 and 155. Copied from Bischoff. Magnified 100 diameters.

Fig. 157.

The same ovarian egg as that represented in fig. 156, cut open with a sharp needle. The mass escaping is *yolk*, with the transparent *germinative vesicle*, in which the *germinative dot* is visible. Copied from Bischoff. Magnified 100 times.

considered as a living body. Segmentation consists in this. Supposing we have here the egg of a dog, copied from Bischoff (fig. 162) : the egg divides itself spontaneously into two halves (fig. 163), which are entirely independent of one another, and only retained together by the common envelope of the yolk. After that, each half divides itself into two halves again, so that the yolk

consists now of four masses of equal dimensions (fig. 164); and so the process goes on. Each quarter of the yolk divides itself again into halves, so that we next have eight such bodies (fig.

Fig. 158.

Ovarian egg of rabbit. Copied from Bischoff's embryology of the rabbit. Magnified 125 diameters.

Fig. 159.

Ovarian egg of rabbit, freed of the cells which surround the zona pellucida in fig. 158. Copied from Bischoff. Magnified 125 times. The *germinative vesicle* shines through the *yolk* as a light spot.

Fig. 160.

The same ovarian egg of the rabbit as in fig. 159, opened with a needle. The yolk, with the germinative vesicle and dot are flowing out. Copied from Bischoff. Magnified 125 times.

Fig. 161.

Ovarian egg of a human female, cut open. The yolk has escaped whole, and in it the germinative vesicle and germinative dot are seen as a lighter spot. Copied from Bischoff. Magnified 100 times. The resemblance to the eggs of the rabbit and dog, represented in figs. 157 and 160, is very striking.

165); first, irregular in shape, but very soon assuming the form of spheres, which fill the cavity of the yolk-membrane. Eight balls,

Fig. 162.

as it were, resulting by spontaneous division in the formation of a mulberry-like body as is represented in fig. 165; and this is divided again, until the eight have become sixteen (figs. 166 and 167), the sixteen thirty-two (fig. 168), the

Fig. 163.

thirty-two sixty-four, and so on until the whole of that mass is separated into little granules which are about as small as the primitive cells of which the yolk consisted (fig 169). We have then a

well-kneaded yolk-mass very similar to what the primitive cell was, only that, instead of simple yolk-cells, it now consists of an innumerable quantity of little spheres which have resulted from the spontaneous division of the whole into successively multiplied halves. There is, however, this difference,—that on one side of the egg there is, when this process is completed, a larger number of these small balls or globules than on the other, and they are more whitish. The difference arises from the fact that the balls multiply more on one side than on the other. In quadrupeds this process of self-division pervades the whole yolk, so that in the centre and on the periphery, and on all sides, it is evenly divided, except that on one side the spheres are somewhat smaller and also somewhat more whitish. In the yolk of a hen

Fig. 164.

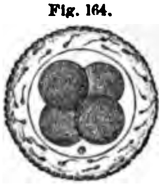
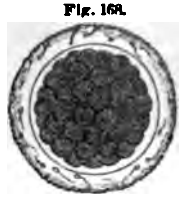


Fig. 165.

Fig. 166.

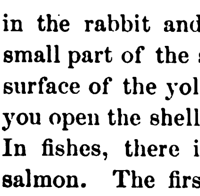
Fig. 167.

Fig. 168.



the process is widely different, and has been known only for a comparatively short time, for in the hen the process also takes place before the egg is laid. In order to examine it, therefore, a hen must be killed and the egg must be observed during its passage through the oviduct, when on the surface of the yolk, and on the surface only, furrows are marked as if made with a nail. These furrows are multiplied crosswise, and then crosswise again, and this process is repeated until the whole surface is changed into these same globular bodies, already noticed in the rabbit and dog, but which in the hen extend only over a small part of the surface of the yolk. Now this small part of the surface of the yolk is that white speck which is seen at once when you open the shell of an egg; and from it the chicken is developed. In fishes, there is still another process. Suppose we take the salmon. The first segmentation of the yolk consists in halving

Fig. 169.



and quartering, and then the process of self-division goes on only in one-half, viz., in the upper half of the yolk, the lower half undergoing no change, so that you have at first only two spheres, one below and one above, then two in the upper part, then four in the upper part, then eight in the upper part, then sixteen in the upper part, the lower part remaining in its primitive condition, and the whole upper part finally being transformed into a body similar to what we have as a whole in the mammal, resting as it were on a cup of unaltered, unchanged yolk in the lower part. In the fish, it is this mulberry-like, segmented portion of the yolk which is changed into the germ, while the other half takes no part in the formation of the germ, but only feeds it, being in fact absorbed into it. The egg is actually a live being, only it is a live being which struggles into its structure by its own activity; and in the formation of the organs it afterward possesses, the process of growth is not one of enlargement simply, but involves such changes as to transform a uniform mass into a variety of systems built of different tissues and endowed with special functions. In the chicken, two parallel swellings first arise along the middle line of the back, leaving a shallow furrow between themselves; and the white disk, spoken of above as a white speck, enlarges and spreads so as to cover the whole surface of the yolk visible from above. If you look at this furrow in a section it will be something like an arch, open above. Gradually this furrow grows wider at one end, with indentations right and left, and then the margins of the disk spread, and, folding downward, enclose more and more of the yolk, and the sides of the furrow thicken, so that represented in profile it will be no longer a shallow furrow, but something like a channel or tube.

At this stage the whole mass has still about the same consistency everywhere. It is like soft jelly and a little pulpy, but presently the two edges of the furrow come more closely together, and finally touch. Meanwhile the margins of the new being rise in a fold and enclose the central parts, forming a sac around the germ, known as the amnios. The natural result of the closing of the upturned edges of the germ is the formation of a cavity, enclosed between these edges. That cavity now fills with a transparent fluid, and as it fills there appears something a little more substantial upon its sides and below it; the walls protecting the cavity become less transparent or even slightly opaque; then the cavity

widens sidewise on its anterior part, and rises a little from the rest. In one word, this cavity forms the channel for the spinal marrow, and its front part the cavity for the brain, and the walls grow to be flesh and bone to form the dorsal spine. The upper part represents the axis of the skeleton, with the surrounding soft parts: the lateral parts form the ribs with their fleshy covering, and, the animal thus closing over the yolk, we have the abdominal cavity. Now, it requires a little more enlargement, a little more change into different substances, to complete the formation of the new being. The gelatinous substance outside the main axis is changed into a fibrous structure, which is muscle. The little opaque bodies in the axis and upon its sides absorb some earthy material contained in the primitive substance from which they have arisen, and thus bone is formed. The fluid in the upper cavity becomes a little more granular and more solid, and it is the brain and spinal marrow. The yolk is absorbed during the process of growth, but the wall within which it is contained is elongated and enlarged, and in consequence of farther changes in the substance of that part of the yolk which is in immediate contact with the body-walls, the alimentary cavity is formed. You have, in fact, all the organs of the animal growing in the same way, by successive transformations of the homogeneous mass into all the various tissues and organs which build up the animal in its perfect condition.

From the time the chick has reached the condition in which all its organs are fairly sketched, it simply grows larger and larger, and finally breaks through the shell. The skin has already become distinct from the muscles; the feathers begin to be formed, and all those parts with which you are familiar may readily be distinguished. You see now by what complicated process (the details of which I have considerably abridged) this is brought about.

I have given you but a meagre outline of the changes which take place in the formation of quadrupeds, birds, reptiles, and fishes, though this may be sufficient to show that these processes must be studied in every animal independently.

The figures on the following page, representing a fish in the egg, show at once how different the growth of these animals is from that of the mammalia and birds. Here we have no amnios; the young fish remains free upon the surface of the yolk. The structure of the body, however, and the circulation of the blood upon the yolk, are strikingly similar to those of the dog, the

chicken, or the little turtle. Compare in this respect the figures of D'Alton with those of Bischoff and my own in the embryology of our terrapene.

Now, what are the conditions necessary for making these observations? A man must be practised, and not only practised, but fully skilled in the use of the microscope. He must know the structure of the animal in its adult condition so accurately, and so completely, that every difference in the structure of the younger animal will at once strike his eye. He must be able to make these comparisons without having specimens before him for comparison;

Fig. 170.

Young Blenny, copied from Rathke's Embryology of the *Zoarces viviparus*. Magnified. Seen in profile from the right side.

Fig. 171.

The same as fig. 170, seen in profile from the left side.

Fig. 172.

The same as figs. 170 and 171, seen in front.

Fig. 173.

The same as figs. 170, 171 and 172 before the egg-shell has burst.

he must have appropriated that knowledge to himself so completely that he may weigh the changes going on in the substance of the germ, merely by the eye, and ascertain every change in so accurate a manner that he may record the facts in their true connection. And more than that, he must be able to prepare the conditions in which these germs will not be altered by being brought under the microscope. Try to bring an embryo, a young chick, in that early stage of growth, as you see it after a few days' incubation, under the microscope, and you are likely to find

hat you have reduced it to a shapeless mass. These objects cannot be handled like a piece of wood. They must be treated with a degree of delicacy which makes it impossible, for instance, for an observer to use any stimulant, even such as coffee and tea, or to eat heartily, or to exercise in any degree which may accelerate the pulse; otherwise his eye will be constantly thrown out of focus. Unless a man has himself under control to that extent, he cannot begin to make good observations. Not only must he have the knowledge necessary, not only must he have the practice necessary, not only must he have the instruments necessary—he must have his own organization so completely under control that he brings himself into that living relation with the object of his observations which alone makes it possible that they shall be accurate. It is not everybody who is willing or able to do this; and then he must carry on his observations by day and night, as the embryo is growing unceasingly, and unless he does continue his observations uninterruptedly, he may miss the most important steps in the progress of growth. Now before you find a man qualified to be an observer, you may have to wait a long while. It was just so during our late war. We did not find the generals who knew how to command, the day of the first battle. It requires years to find a man capable of leading two hundred thousand men. In matters of scientific progress we need a great many students, and large schools, from which to pick out the man who is capable of making new discoveries, or simply accurate investigations; and have we these schools now? Is the number of our scientific students proportionate to the intellectual capacity of the nation? By no means; and until our system of popular education is radically changed, or so far changed, at least, that in all our schools instruction is given in those branches of science which train observers, you may not even have the knowledge necessary to carry on yo practical pursuits, and still less the chances of making any r progress. These results can only be brought about by introduc into our schools that sort of instruction which prepares stud to become observers, or at least, which gives the teacher an op tunity of ascertaining whether any of his pupils may be edu into an observer or not. Such schools we have not, such te we have not, or very few of them—half a dozen in Massach is the sum-total of men qualified to teach in that way; a schools in which they may teach, the apparatus necessary

instruction, we have not. We have to build them up, and we shall not have them before the community understands what are the conditions necessary for the acquisition of new knowledge which may improve the conditions of our success in the practical affairs of a civilized community.

You may ask what text-books you shall take to begin with. There are none that I would recommend. You cannot use the present text-books, for most of them are manufactured by people who know nothing or precious little of the subject about which they write. They are mere compilations, made for the market, by men who have no sort of knowledge of what should be the substance of a text-book; and, what is worse than that, our schools are crowded with so large a number of pupils that the teachers, even the very best of them, have to resort to all sorts of devices in order to keep alive. Instead of teaching, that is, instead of giving out of their knowledge and their substance something by which they can vivify the intellect of their pupils, they are forced by the pressure of numbers to direct their pupils to commit to memory some superannuated book, and to make them recite things not worth knowing. So there we must begin. We must begin by relieving the teacher from a task to which no human being is equal; for it is impossible for any one person to teach eighty pupils well, in one and the same room, at the same time, and to teach every branch of human knowledge in close succession. It is physically impossible. It is past endurance; and all those who have tried to do this kind of work, honestly and faithfully, have paid for the effort with the loss of health. And then there is another point. In order to get men capable of performing the difficult task of teaching, you must give greater inducements to able intellects to devote themselves to the task. The teacher's profession must not be the least remunerative of any profession in the community, as at present it is. Only those who by nature cannot help being teachers go into it, and their willingness to teach is misused by the community by giving them a pittance for their existence. So one more thing is needed: you must organize normal schools to educate teachers of natural history and science generally. You must not only determine that you will introduce these branches of knowledge into your schools, but you must prepare teachers for the task.

ON STAUROLITE CRYSTALS AND GREEN MOUNTAIN GNEISSES OF THE SILURIAN AGE.*

BY PROF. J. D. DANA.

In a paper published in the "American Journal of Science" in 1872 I mentioned the fact, first noticed by Percival, that crystals of staurolite are found in Salisbury, Connecticut, in mica schist "underlying" directly the Stockbridge or Canaan limestone. Since then I have found in southern Canaan, at a locality in Falls Village, west of the Housatonic River (to which I was directed by Dr. Stephen Reed of Pittsfield), crystals of this mineral in a very similar, well-characterized mica schist; but in this case, the schist *overlies* the limestone and is, therefore, the newer rock.† This staurolitic mica schist contains also small garnets. The order of superposition is free from all doubt, for the Canaan limestone outcrops at the bottom of the same hill, from beneath the schist, and the dip is not over fifteen degrees.

The age of the Stockbridge limestone is admitted by all recent writers on the subject to be Lower Silurian. Logan referred it to the Quebec group or the formation next below the Chazy. But since then Billings has described fossils from the same limestone at West Rutland, which he has identified as Chazy. And the Crinoids and other species, mentioned in the "Vermont Geological Report" as found in the limestone at other Vermont localities appear to show, as long since suggested by Professor James Hall, that the Trenton limestone is also present in the formations. The Chazy and Trenton limestones (Black River included) follow one another in New York, and the west and south. That the Canaan limestone is the same identical stratum that occurs at Stockbridge in Massachusetts, and farther north at Pittsfield, I know from a personal tracing of the rock throughout this region; and examinations still farther north in Massachusetts and Connecticut lead me to believe in the conclusion of the geologists of the Vermont survey, that all is one formation—the Stockbridge limestone, or the Eolian as Hitchcock named it.

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* Read at the Portland Meeting of the Amer. Assoc. Adv. Sci.

† From facts I have observed elsewhere, I think it probable the Salisbury schist is also an *overlying* rock.

The fossils found in Vermont lead to the conclusion that the limestone represents the Trenton era as well as the Chazy. The overlying mica schist and other associated rocks have a thickness of at least three thousand feet; and, if the limestone is Trenton in part, they belong to an era later: either to a closing part of the Trenton period, or to the period of the Hudson River or Cincinnati group.

In any case there is no reason to doubt that the staurolites occur in rocks of the later part of the Lower Silurian age, and strong reason for the conclusion that these schists are in age veritable Hudson River rocks.

On this view, the Hudson River or Cincinnati group, in the Green Mountains — alike in Connecticut, Massachusetts and Vermont, — includes beds of quartzite, mica schist, chloritic mica slate, hydro-mica slate (the talcose slate of the earlier geologists), well-characterized gneiss of various kinds, some of it much contorted, and granitoid gneiss.

At a locality at South Canaan village, in Cobble Hill, the lowest rock over the limestone is quartzite; next follows mica schist passing into gneiss; and above this there is a light-colored granitoid gneiss, breaking into huge blocks with very little of a schistose structure.

Near the boundary of the towns of Tyringham and Great Barrington, four miles east of the latter village, a locality long since studied by Mr. R. P. Stevens of New York, and by him pointed out to me, there are, over the limestone, alternating beds of quartzite gneiss and limestone dipping at a small angle to the eastward. Commencing below, the succession is

1. Granular limestone, that of the valley.
2. Mica schist, a thin bed.
3. Hard jointed quartzite, 30 feet.
4. White granular limestone, 60 feet.
5. Hard jointed quartzite, 20 feet.
6. Gneissoid mica schist, 30 feet.
7. Bluish granular limestone, 40 feet.
8. Mica schist, 6 to 8 feet.
9. Quartzite, partly laminated, 120 feet, forming a high bluff,— the site of Devany's hearthstone quarry; and then
10. Gneiss, forming the top of the bluff, and having great thickness in a ridge to the northeast, but in its upper portions becoming very silicious or in part quartzite.

The fact that quartzite, limestone and gneiss or mica schist here alternate with one another is beyond question; and, if I am right in the age of the deposits above suggested, the alter-

nations occur at the junction of the Trenton and Hudson River formations.

The above section occurs on the east side of a small open valley. On the west side of the same valley the foot of the bare front of the hill consists of quartzite, dipping slightly to the north-westward, as if one side of a very gentle anticlinal of which the rock of the Devany quarry is the opposite. The quartzite, although hard and generally pure, contains a layer of mica schist ten inches thick which becomes pure quartzite a hundred feet to the eastward. Above the quartzite follows gneiss, which continues westward three miles, in a shallow synclinal, to Great Barrington, and there this gneiss is overlaid by a second thick stratum (100 feet or so) of quartzite. Here, then, there are two strata of quartzite separated by two or three hundred feet of gneiss, the whole overlying the Stockbridge limestone. The gneiss is a very firm rock, covering the slopes in some places with blocks like houses in size, where upturned through the growth of trees. I had suspected that it was one of the older gneisses of New England, until I found that it was overlaid by quartzite, and, on tracing further the stratification, proved that it belongs unquestionably to the series of rocks newer than the limestone.

From the facts which have been presented it follows that all old-looking Green Mountain gneisses are not præ-silurian, and, further, that the presence of staurolite is no evidence of a præ-silurian age.

NOTE ON BUFO AMERICANUS.*

BY REV. DR. THOMAS HILL.

This note is intended as a contribution toward the psychol of the American toad; simply presenting some evidences of telligence and of capacity for learning to which I have ' witness.

In the summers of 1843–5, an old toad used to sit unde door of a beehive every fine evening, and dextrously pick up bees which, overladen or tired, missed the doorstep and fell

* Read at the Portland Meeting of the Amer. Assoc. Adv. Sci.

ground. He lost, by some accident, one eye, and it was observed by several members of the family, as well as myself, that he had with it lost his ability to pick up a bee at the first trial; his tongue struck the ground on one side the bee: but after several weeks' practice with one eye he regained his old certainty of aim.

I have never seen our toad use his hands to crowd his food into his mouth as the European toad is said to do; although he uses them freely to wipe out of his mouth any inedible or disagreeable substance. When our toad gets into his mouth part of an insect too large for his tongue to thrust down his throat (and I have known of their attempting full grown larvæ of *Sphinx quinquemaculatus*, and even a wounded hummingbird) he resorts to the nearest stone or clod and presses the protruding part of his mouthful against it and thus crowds it down his throat. This can be observed at any time by entangling a locust's hind legs together and throwing it before a small toad.

On one occasion I gave a "yellow-striped" locust to a little toad in its second summer, when he was in the middle of a very wide gravel walk. In a moment he had the locust's head down his throat, its hinder parts protruding; and looked around for a stone or clod, but finding none at hand, in either direction, he bowed his head, and crept along, pushing the locust against the ground. But the angle with the ground was too small and my walk too well rolled. To increase the angle he straightened his hind legs up, but in vain. At length he threw up his hind quarters, and actually stood on his head, or rather on the locust sticking out of his mouth,—and after repeating this once or twice succeeded in "getting himself outside of his dinner."

But these instances of ingenious adaptation to the circumstances, were exceeded by a toad about four years old at Antioch college. I was tossing him earth worms while digging, and presently threw him so large a specimen that he was obliged to attack one end only. That end was instantly transferred to his stomach, the other end writhed free in air, and coiled about the toad's head. He waited till its writhings gave him a chance, swallowed half an inch, then taking a nip with his jaws, waited for a chance to draw in another half-inch. But there were so many half-inches to dispose of that at length his jaws grew tired, lost their firmness of grip, and the worm crawled out five-eighths of an inch, between each half-inch swallowing. The toad, perceiving this, brought his

right hind foot to aid his jaws, grasping his abdomen with his foot, and, by a little effort, getting hold of the worm in his stomach from the outside; he thus by his foot held fast to what he gained by each swallow, and presently succeeded in getting the worm entirely down.

A garter-snake was observed this summer in North Conway pushing a toad down his throat by running it against clods and stones; just as the toad crowds down a locust.

The amount which a toad can eat is surprising. One Tuesday morning I threw a *Coreus tristis* to a young toad, he snapped it up, but immediately rejected it, wiped his mouth with great energy, and then hopped away with extraordinary rapidity. I was so much amused that I gathered some more of the same bug and carried them to a favorite old toad at the northeast corner of my house. He ate them all without making any wry faces. I gathered all that I could find on my vines, and he ate them all, to the number of twenty-three. I then brought him some larvæ of *Pygæra ministra*, three-quarters grown, and succeeded in enticing him to put ninety-four of them on top of his squash bugs. Finding that his virtue was not proof against the caterpillars when I put them on the end of a straw and tickled his nose with them, he at length turned and crept under the piazza, where he remained until Friday afternoon, digesting his feast.

A gentleman having read this paper told me he had seen the toad tuck in the last inch of an earth worm with his hand, European fashion. I then remembered that I have several times seen our toad put the last quarter-inch of earthworms in with his hand; but never saw him take his hand to a locust.

ON SECTION *AVICULARIA* OF THE GENUS *POLYGONUM.*

BY SERENO WATSON.

MEISNER's *Polygonum* §*Avicularia* is equivalent nearly to section *Polygonum* of Linnæus, the original genus *Polygonum* of Tournefort and Adanson, to which Linnæus added, as coördinate sections, *Persicaria*, *Bistorta* and some other old genera. Its most dis-

tinctive characteristics are the leaf jointed upon the petiole at the point of divergence from the sheath; the broadly dilated filaments of the three inner stamens; and the incumbent cotyledons. Of these the first occurs in no other section of the genus, excepting § *Tephis*, of a single species, but is found in *Atraphaxis*, *Thysanella* and *Polygonella*, of the subtribe *Rumiceæ*. The second is also peculiar to § *Tephis*, but exists in *Atraphaxis* and a section of *Polygonella;* while the third, occurring besides only in § *Amblygonon* of *Polygonum*, is characteristic of *Rumex*, *Atraphaxis*, *Thysanella* and some species of *Polygonella*. The closest affinity of the section is to the genus *Atraphaxis*, which has also perfect flowers and the same peculiar stipular sheaths, and from which it is distinguished mainly by its more or less herbaceous sepals not enlarging or deflexed in fruit but appressed to the achenium. It would seem that the genus *Polygonum* should be restricted to the two sections *Avicularia* and *Tephis*, on account of this, in these respects, nearer relationship to the *Rumiceæ* than to the other sections with which they are at present united.

The species *P. articulatum*, which was long retained in § *Avicularia*, but referred by Meisner to *Polygonella*, and restored by Dr. Gray to *Polygonum* as § *Pseudo-polygonella*, must be placed with *Polygonella ericoides* (which includes *P. Meisneriana*), having a similarly excentric embryo, somewhat contorted, and the cotyledons either accumbent or incumbent. Its scarcely dilating inner sepals are those of *Polygonella polygama* (*P. parvifolia*), and its colored marcescent calyx, the solitary flowers upon elongated pedicels jointed near the middle, and the peculiar floral sheaths, are common to all the species of *Polygonella* in contradistinction to those of *Polygonum*.

The section *Avicularia* and the North American species belonging to it may be defined and arranged as follows:—

§ AVICULARIA, Meisn. Calyx more or less herbaceous, at length connivent upon the achenium, 5- or rarely 6- parted; stamens 5–8, sometimes but 3, the filaments opposite to the inner sepals broadly dilated; achenium 3-angled; albumen horny; embryo lateral with incumbent cotyledons. Herbaceous, or somewhat woody at base, never climbing nor aquatic; leaves jointed upon the short petiole; stipules hyaline at least above the sheath, the lateral lobes entire or bifid, at length lacerate; flowers axillary or apparently spicate by the abortion of the floral leaves, cymosely fascicled in the sheaths or rarely solitary, the pedicels jointed to the short base of the calyx; bractlets hyaline.

* Smooth perennials (*P. maritimum* sometimes annual), the chestnut-brown stems somewhat woody at base, the slender branches leafy to the top; leaves thick; stipules conspicuous; calyx mostly colored, rather large and open, exceeding the lanceolate smooth achenium and loosely appressed to it; stamens 8.

1. P. Bolanderi, Brewer, *Proc. Amer. Acad.*, viii, 400. — Stems erect, very slender, 6-15′ high, nearly naked, with short simple densely leafy branches above; leaves narrowly linear, 2-4″ long, often cuspidate; stipules about equalling the leaves, finely lacerate; flowers mostly solitary, 1½″ long, light rose-color; styles half as long as the ovary.— Sacramento Valley, California.

2. P. Shastense, Brewer, *l. c.*— Prostrate or ascending, the branches 2-6′ long, usually naked; joints very short; the lacerate lobes of the stipules mostly deciduous from the herbaceous sheath; leaves oblanceolate, 4-6″ long, often folded, not revolute; flowers 1-3 in the lower axils of the leaves, which crowd the ends of the branches, deep rose-color, 1½-2½″ long on exserted pedicels; styles much shorter than the ovary.— In the Sierra Nevada, California.

3. P. Paronychia, Cham. and Schlecht.— Prostrate, the branching stems 1-3° long; leaves linear-lanceolate, ½-1′ long, acute, the margins revolute; flowers densely crowded at the ends of the branches, rose-color, 3″ long; styles as long as the ovary. — On the seacoast from San Francisco to Puget Sound.

4. P. maritimum, L.— Prostrate, glaucous, stems ½-1½° long, very shortly jointed; leaves oval to linear-oblong, 3-10″ long; flowers 1-1½″ long, on mostly exserted pedicels; achenium equalling or slightly exceeding the sepals.— On the seacoast from Massachusetts to Georgia; usually annual in the more northern localities; not distinguishable from the Old World species.

* * Annuals, with striate stems leafy throughout; calyx colored upon the margins, becoming closely appressed; styles short.

5. P. aviculare, L. — Mostly prostrate or ascending, glabrous, bluish-green, the branches slender and elongated; leaves oblong to lanceolate, 3-10″ long, usually acute or acutish; flowers rarely 1″ long, pinkish-white, the pedicels not exserted, stamens 8 or rarely 5; achenium broadly ovate, 1″ long or less, dull and minutely granular. — Common about yards and roadsides; probably not indigenous.

6. P. erectum, L.— Stouter, erect or ascending, glabrous, 1-2° high or more, yellowish; leaves oblong or oval, ½-2½′ long, usually obtuse; flowers mostly 1½″ long, often yellowish, on more or less exserted pedicels; sepals rarely 6; stamens 5-6; achenium broadly ovate to lanceolate, dull and granular or nearly smooth.— From the Eastern States and Canada to Nevada and Oregon; a strictly American form.

7. P. minimum, Watson, *King's Rep.*, v, 315.— Somewhat scabrous-puberulent; stems very slender, decumbent or ascending, 6-15′ long (or an alpine form, very dwarf), brownish and often flexuous; leaves ovate to lanceolate, 2-8″ long, acute at each end and sometimes cuspidate; flowers in all the axils, 1″ long or usually less, light rose-color, on very slender exserted pedicels; stamens 8; styles short; achenium smooth and shining, exceeding the calyx.—In Oregon (Pickering, 452 Hall), and in the Wahsatch and Uintas at 9-11,000 feet altitude.

8. P. Torreyi.— Closely resembling the last, but perfectly smooth; the flowers mostly near the ends of the branches and nearly sessile in the axils of the crowded leaves; stamens 6; achenium considerably exceeding the calyx. — Collected by Dr. Torrey in the Yosemite valley.

* * * Annuals with striate stems, the branches slender and virgate, angular; leaves diminishing upward and becoming bractlike, the spikelike inflorescence more or less interrupted.

9. P. ramosissimum, Michx.— Erect or ascending, 2-4° high, glabrous, yellowish leaves lanceolate to linear, 1-2½′ long, acute; flowers and achenium as in *P. erectum*, bu the sepals more frequently 6, the stamens 3-6, and the acheuium mostly smooth an shining. — From the northern Atlantic States to the Saskatchewan and the Pacific.

10. P. tenue, Michx.—Erect, ½-1½° high, glabrous or rarely slightly scabrous at t nodes; leaves linear to lanceolate, 1-2′ long, acute at each end and often cuspidate, scurely 3-nerved; flowers often solitary, 1-2″ long, deflexed in fruit, the sepals margin with white or pink; stamens 8; styles much shorter than the ovary; achenium ov black and shining.— From Canada to the Carolinas and west to Oregon. Var. lat lium, Engelm., has broader leaves and more numerous flowers; Var. microsperm Engelm., is a low slender form, with minute flowers and fruit, perhaps distinct; occur in the Rocky Mountains.

11. P. CAMPORUM, Meisn.—Smooth, erect or ascending, 2-3° high, the branches short-jointed and branchlets mostly terete; leaves linear-lanceolate, 1-2' long, acute, or sometimes oblong, but ½' long and obtuse; bracts hardly exceeding the flowers; pedicels slender, exserted from the short sheaths; sepals colored, ½-1" long; stamens 8; styles nearly equalling or at least half as long as the achenium; fruit less deflexed than in the last.—Texas to Kansas. Meisner was mistaken in classing this with the perennial species, and perhaps also in referring to it the South American var. *australe*.

12. P. COARCTATUM, Dougl.—Resembling *P. tenue*, but scabrous-puberulent, the stems often brown; leaves linear, acute, 1-nerved; spike usually rather dense; calyx more petaloid and conspicuous, 1-2" long; styles as long as the ovary.—From Puget Sound and central Idaho to the Sacramento.

**** Low slender annuals, the spikes short and dense, and the bracts imbricated; sepals colored.

13. P. POLYGALOIDES, Meisn.—Stems 2-6' high, smooth, branching; leaves narrowly linear, ½-1' long, acute; spikes dense, 3-8" long, the bracts closely imbricated, 2" long, oblong to nearly orbicular, with broad scarious margins, mostly obtuse; stipules lanceolate, entire or lacerate; sepals 1" long or less; stamens 8; styles as long the ovary; achenium ¾" long, minutely tuberculate-striate or smoothish.—Collected only by Spalding and Pickering, in Oregon and central Idaho.

14. P. IMBRICATUM, Nutt., in herb.—Resembling the last; often diffusely branched, 1-8' high; bracts loosely imbricated, linear or oblong, 2-4" long, with sometimes a narrow scarious margin, acute; stamens 3 or 5; styles one-third as long as the ovary.—Frequent in the mountains, alpine and sub-alpine, from Colorado to Oregon and northern California. It has usually been considered a form of *P. coarctatum*.

Meisner refers also to this section his *P. Californicum*, founded upon 1944 Hartweg, without fruit. It is separated, however, by every character but habit, and the remarkable peculiarities of the achenium require that it should be placed in a distinct section, not very closely allied to any other in the genus, as follows:—

§ DURAVIA. Sepals 5, colored, becoming somewhat appressed to the achenium; stamens 8, the three inner filaments but slightly dilated at base; styles 3, the stigmas capitate; achenium membranous, linear, nearly terete, obscurely 3-angled; embryo lateral; cotyledons accumbent; flowers in slender many-jointed interrupted spikes, mostly solitary and nearly sessile in the sheaths; the scarious stipules not lobed, finely lacerate; leaves linear, not jointed upon the petiole.

1. P. CALIFORNICUM, Meisn.—Annual, erect, very slender, 3-6' high, minutely scabrous-puberulent, brownish, the branches mostly floriferous their entire length; leaves linear to filiform, 6-15" long, cuspidate; bracts 1-2" long, 3-nerved, but little exceeding the stipules; calyx 1" long, rose-color; styles much shorter than the ovary; achenium slightly exserted, the light-colored pericarp thinly membranous, rather closely enveloping the terete seed, with slightly raised angles; testa reddish.—On dry hills bordering Sacramento and Napa Valleys, California.

THE STRUCTURE OF THE SCALES OF LEPISMA SACCHARINA.

BY G. W. MOREHOUSE.

FOR many years this test has been subjected to most careful and critical examination by the most competent observers and with the best microscopes, but, after all, the true character of its markings still remains a disputed question. These differences of opinion have evidently arisen partly from the complex nature of the markings themselves, and partly from the different conditions under which they have been seen. In this scale we have coarse ribs easily seen with a very ordinary glass, and on the other hand delicate structures severely taxing the powers of the finest objectives in existence. This fact alone is sufficient to account for the want of agreement, without accusing any person of being biassed by a theory; while those observers who think their own instruments are the best will continue to be satisfied with what they may happen to see, and shut their eyes to any advance.

As the microscope has been improved, our ideas of the structure of the Lepisma scale have been gradually modified, and who will now claim it to be "too easy for a test object?"

In the order of difficulty of resolution we have—

1. The heavy longitudinal ridges running from end to end of the scale and slightly projecting at the point.

2. Distinct ribs generally radiating from the quill, or curved parallel with the outline of the scale, and becoming faint in the centre and parts remote from the quill.

3. Transverse corrugations of the membranes.

4. Faint irregular veins branching from the diverging ridges (No. 2) generally taking a transverse direction, and, together with the corrugation, causing the spurious appearance of fine beading at their points of intersection with the ridges.

To make sure of my work on this scale I have studied it under a number of different conditions. The observations have been conducted with monochromatic sunlight; with white cloud and lamp; with central beam and oblique; with mirror, prisms, achromatic condenser with and without central stops, and with Wen-

ham's paraboloid. All these methods point to the same conclusions. Following up the line of observations described by the late Richard Beck, in his most valuable contribution to our knowledge of this subject, the same results were arrived at in regard to the appearance of coarse beading, etc., viz., "that the interrupted appearance is produced by two sets of uninterrupted lines on different surfaces" * That the longitudinal and the oblique lines are on different sides of the scale is also plainly seen by their lying in different focal planes under a $\frac{1}{50}$ objective. And farther, while examining a scale in fluid I have repeatedly observed air bubbles on one surface of it confined by the longitudinal ribs, and on the other side others bounded by the oblique ridges; and on moving the slow adjustment up and down, with the movement of the bubbles under control, they never interfere or mix with each other.† Nothing further is required to prove that these markings are actually ridges and that they project from different surfaces of the object. The experiments of Mr. Beck settle this question.

As microscopical definition advanced the very feeble radiating lines were noticed in the spaces between the ribs, formerly thought to be smooth. In the central portion of the test these lines are parallel with the main ribbing. They in their turn were seen to be uneven and pronounced to be "beaded striæ."‡ Must this fine beading like its shadowy predecessors be also extinguished by intersecting cross lines and so add one more to the long list of illusory appearances? To attempt to throw some light upon this question is the principal object of the present article.

In the first place, it is far from being a difficult feat to see this beading. Any first class lens, from a $\frac{1}{5}$ upward, when properly handled, will display it or something very like it. The writer has found it an easy task with Wales' $\frac{1}{15}$ immersion, or even with a Beck $\frac{1}{5}$ and deep eye-piece. With Tolles' $\frac{1}{50}$ immersion the fine transverse structure indicated above is brought out, and it becomes at once evident that the small beads are indeed spurious like their big brothers, and for a similar reason.

The fine transverse markings seem to branch from the faint radiating ones and have the appearance of a net-work of minute capillaries. Beside these there are coarser transverse waves or

* The Achromatic Microscope, Beck, p. 50.

† See Micrographic Dictionary, 2d ed., p. 34, Fig. 3, pl. 27.

‡ See M. M. Journal, March, 1873, pl. xi, Figs. 3 and 4.

corrugations of the membrane. In numerous instances, air bubbles have been observed imprisoned between the heavy ribs on one or two sides, and by these corrugations on the other sides. Therefore the corrugations may safely be said to be on the same surface of the scale with the longitudinal ridges, and the branching vein-like structure on or near the other surface. Careful focussing is corroborative of this idea, making it certain that these two details of structure lie in different planes. With monochromatic light, the delineation of this structure is eminently satisfactory, and the effect of the slightest change in focal adjustment is at once felt. When the object is a little out of focus the light is unequally refracted and broken up in passing through this complicated network of ridges and corrugations, and produces an appearance of fine molecules over the whole surface of the scale.

The coarse and the fine beads both vanishing under advancing definition, together with the behavior of the confined bubbles of air, seems to my mind fully to demonstrate the reality of the structure above described. Often, when the corrections are not perfect, the semblance of beading can be directly traced to a seeming enlargement of points of linear intersection and branching. When the $\frac{1}{50}$ is at its best work the finer transverse markings are usually irregular both in strength and direction but always unmistakable. They may be plainly seen on some of the smaller scales and in the central parts of the larger, and at almost as good advantage as near the edges of the easier scales. Sometimes they are continuous across several intercostal spaces and again only extending across one, or it may be merely budding, as it were, from the ribs. It will be noticed that the "beads" as drawn by Mr. Hollich exhibit corresponding irregularities.

In conclusion the remark of Beck on the scales of Lepidocyrtus may well be quoted—"and my own belief is that the markings upon this and all other varieties of Podura-scales are more or less elevations or corrugations upon the surface, which answer the simple purpose of giving strength to very delicate membranes."* If this idea is true of the Podura it applies with greater force to the complicated ridges of Lepisma.

The same original structure is often modified in diverging directions so as to subserve totally distinct purposes. And as hairs are probably modified scales, and a regular gradation may be

* Transactions R. M. S., 1862, p. 83.

traced between them, so the connecting chain is filled up between ribs extending from end to end of a scale, through undulations and shorter ribs, to those slightly projecting, and so on to the perfect spine or secondary hair.

THE NORTH AMERICAN GOATSUCKERS.

BY DAVID SCOTT.

THE whippoorwills and nighthawks of North America are by many confounded and considered to be the same species. This impression is, nevertheless, entirely erroneous; and I hope to show, in the following remarks, such obvious differences existing between them as will convince the most superficial observers of their non-identity.

It is surprising that our farmers (for they perhaps are the persons by whom these birds are most generally confounded) should consider such widely separated species, which resemble each other in color only, the same. It exhibits a carelessness which is hardly excusable, for doubtless the majority of them have shot the birds in question, and a simple comparison would surely convince them of their error. That any supernatural ideas should be entertained respecting these harmless and useful birds appears even more surprising; but such is the case with a large number of people, more especially, however, with the uneducated. There is prevalent in various sections of the country a remarkable awe, not to say fear, of them: and various are the misfortunes which are ascribed to their supposed supernatural influence—such as the sudden death of one of the inmates of a house, which, it is affirmed, surely follows the song of the whippoorwill if he be perched upon the door-sill. It is also believed by some that the white spots on the wings of the nighthawks are silver dollars. The pertinacity with which superstitious traditions cling to people is well known, and the foregoing, which are not all that are current respecting these birds, form no exception. They have undoubtedly been handed down and preserved through many generations. It appears remarkable, but there seems to be something about these birds which has excited the superstition of various nations for

ages back. Their very name implies this. The appellation "goatsuckers," which has now extended to the whole family, was, without doubt, suggested by their very wide gape. This led to the idea entertained by the ancients that they sucked goats.

In the west these birds have been accused of the crime of sucking milk from cows—about as probable as snakes being guilty of the same offence; yet there are hundreds who believe in such impossibilities: and to this belief may be attributed the cause of their being birds of evil omen in the estimation of our rural population. These mistaken notions have been current since the days of Aristotle, if not still further back. Absurd as they may appear to an enlightened and reflecting person, they are, nevertheless, firmly believed by many, which may to a certain extent account for the universal ignorance of the birds as well as of their habits.

The main reason, however, that these birds are confounded is in reality due to the great dissimilarity in their habits; for the nighthawks are often seen, and only occasionally heard, while the whippoorwills are frequently heard and seldom seen: and their very similar appearance when asleep or resting for the day (the whippoorwills being seldom observed at any other time) tends also to confirm the opinion that they are the same species.

The family *Caprimulgidæ*, to which these birds belong, is divided into three sub-families, *Steatornithinæ*, *Podarginæ* and *Caprimulginæ*. The latter only is represented in North America, and by two genera, *Antrostomus* Gould, the whippoorwills, and *Chordeiles* Swains., the nighthawks; the former of which contains three species, the latter two.

The common whippoorwill (*A. vociferus* Bon.) is an inhabitant of eastern North America from Canada to Florida, where it is replaced by the chuck-will's-widow (*A. Carolinensis* Gould). Its range to the westward appears to be restricted to Leavenworth, Kansas,* where it is again represented by a still smaller species, the *A. Nuttalli* Cass., or "poor-will."

It is a summer sojourner in the District of Columbia, where it usually arrives from the south the last of April or the first of May. Although I have observed it as early as the thirteenth of April its arrival at that early period is of rare occurrence. The males generally precede the females a few days, and soon after the latter

* Bull. Mus. Comp. Zoöl. July, 1872.

make their appearance the wonted and necessary place for incubation is prepared. It cannot, however, be called a nest; as it is merely a shallow hole scraped in the ground, in close proximity to its accustomed companion, a rock, stump, or fallen tree. The eggs are from one to three in number, of a delicate creamy-white color, with blotches of different shades of lilac and pale brown: they are laid in the early part of May. The young are out by the first of June, if not earlier, and are very curious looking little creatures, covered with a fine down of a yellowish color. As soon as they are able to leave the nest, the mother guides them in their search for insects until they are able to use their wings. When surprised in these excursions, it is amusing to witness with what solicitude she hastens to lead them to a safe retreat. But if the intruder (especially if a human being) persists in following, and approaches too closely, she turns off in another direction, feigns lameness and incapability of flight, flutters along for a few rods ahead, and exerts herself to the utmost to allure the interloper from her offspring. After having decoyed the stranger, as she thinks, a sufficient distance, she suddenly regains her power of flight, and darts off to the protection of her helpless progeny. This species roosts almost exclusively on the ground, although it has occasionally been found upon a tree. When disturbed in the daytime it rises as silently as a shadow, and flies off in a confused zigzag manner, but immediately settles within a few rods. But when the shades of evening advance it comes boldly forth from its roosting places in the most invious and secluded parts of the forests, to search for the night-flying *Lepidoptera*, of which it destroys countless numbers. It is then that we hear its lively whistle in company with the loud, hoarse, guttural hŏŏ-hŏŏ-hŏŏ-hŏŏ-ē, of the great-horned owl (*Bubo Virginianus*); the quivering-wailing cry of the screech owl (*Scops asio*); the croaking of frogs, and the song of the cricket and the katy-did: which form quite a contrast to the beautiful songs of the thrushes which enliven our forests and groves during the day.

The chuck-will's-widow (*A. Carolinensis* Gould) is the largest North American species. In its habits and general appearance it resembles the common whippoorwill, with which it is generally confounded by inexperienced observers. Its range in the United States has usually been supposed to be limited to the south Atlantic and gulf states, being seldom if ever seen north of the Caro-

linas on the coast. But Mr. Ridgway is confident that he has heard it in southern Illinois;* which, if his observation proves correct, will be but another instance exemplifying the well-known fact of birds having a more extensive latitudinal distribution in the interior than upon the coast; which is doubtless subject to, and explicable by, climatic influence. Its notes, from which it takes its name, resemble less then has generally been supposed the syllables "chuck-will's-widow." They are pronounced in a rapid manner with a slight elevation of the voice upon the last syllable. Butterflies, moths and a variety of other insects, form its food, as they do also that of the other members of this group.

The next is Nuttall's whippoorwill (*A. Nuttalli* Cass.), or more properly "poor-will," as it is said to omit the first syllable. It inhabits the country west of the Mississippi river, and is domiciled in nearly every part of that vast extent of prairies. This is the smallest species, measuring only eight inches in length. Its habits differ essentially from its eastern congeners, as it is necessarily an inhabitant of open portions, and is unconversant, if I may so use the expression, with the woods which they so delight in frequenting. The eggs are immaculate livid white and destitute of spots or blotches, and, with *A. macromystax* of S. Mexico, differ in this respect, from all the other species.

We now come to the nighthawks (*Chordeiles*). The common nighthawk or "bull-bat"(*C. popetue* Baird) of the eastern states is abundant from British America to the West Indies, and west to Kansas, where it becomes lighter, and constitutes the variety *Henryi* Cass. This bird is an abundant spring and autumn visitant to the District of Columbia, arriving about May first, and departing the last of September. In its breeding habits it differs from the whippoorwill in constructing its nest, which is a mere hole scratched in the ground, in open places, as fields and bare hillsides; and never in thick woods. It sometimes deposits its eggs on a dead leaf, or even on a bare rock. During the pairing season the actions of the male are strange and interesting. At dusk he frequently mounts high into the air, and then, partially closing his wings, descends with great rapidity to near the earth; the air in passing through the wing feathers in this rapid descent produces a loud booming sound which may be heard at a considerable distance, and has been likened to the noise occasioned

* MS. Notes on Birds of S. Illinois.

by blowing into the bung-hole of an empty barrel. This noise must be regarded as a means of bringing the sexes together, as it is heard only in the spring. In the intervals between his ascensions, the male darts around in every direction, uttering sharp squeaks and throwing himself into all sorts of attitudes and postures, calculated, no doubt, to please any passing female. It is both diurnal and nocturnal in its habits, but more properly the latter. Nevertheless, I have frequently seen numbers pursuing and capturing their prey in broad daylight, when the sun was shining brightly. At such times, however, their flight is very high, so high indeed that they resemble the swallows with which they associate, and if it were not for the slow and regular flapping of their long wings, and an occasional harsh note (a note of exultation perhaps as they snap up some unfortunate beetle or moth) they might readily be mistaken for them. But it is in the dusk of the evening that they may be seen in the greatest numbers; when, in certain localities and at certain seasons of the year (especially in the fall), thousands may be seen darting around in their rapid and necessarily irregular flight. As darkness approaches, they descend to the earth and skim along the surface, snatching up any ill-fated bug that may have failed to find shelter.

I recollect a small valley in the northern part of Pennsylvania, which appears to be a favorite resort of this bird, more especially in the fall. It is about five miles in length, a mile in width, is inclosed by two ranges of high mountains, and is one of the most picturesque places in the state. A small stream wends its way along the base of one of the ranges and empties itself into the Susquehanna hard by. An hour or two before dusk a few night-hawks will be seen approaching from the direction of the river. These have no sooner passed than more make their appearance; and thus they come in an ever increasing stream, twisting and turning in pursuit of their insect prey, but always keeping in a general direction up the valley. In about fifteen minutes the foremost will have reached the head of the valley, and having turned, as is their invariable custom, will be seen drawing near in their return to the river. In this way they may be seen coming and going with continually increasing numbers, until the sky is dark with their fleeting forms, and night has thrown a veil over their actions. I have watched them for hours in this locality. When they first appear they are high in the air, but as dusk ap-

proaches their flight is lower; which is occasioned by the insects that they are pursuing seeking shelter for the night. Unlike the whippoorwill, this bird roosts almost entirely upon trees; in fact it is seldom found on the ground except during the breeding season. In roosting it always rests in a parallel position with its perch. This is undoubtedly owing to its comparatively small and weak legs, which are not capable of sustaining it any length of time in a transverse posture.

The western nighthawk (var. *Henryi* Cass.) was formerly considered to be a distinct species, but is now regarded as only a geographical variety of the preceding; the principal difference being a paler coloration caused by a predominance of the lighter markings. It inhabits the same region as Nuttall's whippoorwill, or the whole of the western country.

The Texas nighthawk is much smaller than either of the preceding, and is very distinct, its nearest relative being a South American species (*C. acutipennis*). It is a more southern bird than the others, and is found most abundantly in the state from which it derives its name.

DIAGNOSES OF GENERA AND SPECIES OF NORTH AMERICAN CAPRIMULGINÆ.

A. Wings, comparatively speaking, short and rounded, with rufous spots; second quill longest; the primaries emarginated on their outer webs. Tail broad and graduated, the terminal third, half or two-thirds of three outer feathers rusty white. Plumage soft and lax. The gape armed with very large and stiff bristles. Entirely nocturnal in habits. ANTROSTOMUS Gould.

1. Length 12·00; extent 25·00; wing 8·50; tail 6·50. Prevailing color above and below pale rufous; top of head reddish brown, streaked longitudinally with black. Terminal two thirds of three lateral tail feathers rufous white, with a slight mottling on all the outer webs for nearly their whole length. Tail but slightly graduated, the exterior feathers a quarter of an inch only shorter than the middle ones. Bristles of bill with lateral filaments. Female without white patch on tail. Habitat, south Atlantic and gulf states. Cen. Amer., S. Ill.? *A. Carolinensis* Gould.

2. Length 10·00; extent 19·25; wing 6·25; tail 5·00. Top of head, rump, upper tail coverts and inner tertials, ashy-gray, barred longitudinally with black; the streaks on the head becoming confluent in the centre, forming a large medial black band. Middle of back brownish black. Throat and fore breast the same. A white collar on the under side of the neck, the ends extending up on each side and nearly meeting a rufescent band curling around the nape. Rest of under parts light brownish white, barred transversely with dark brown. Wings brown, the quills spotted with rufous. Tail dark brown, with about eight interrupted light bars; the terminal half of three outer feathers rusty white. Graduation ·80. Bristles of mouth without lateral filaments. Female with no white on tail. Habitat, eastern U. S. to Kansas. *A. vociferus* Bon.

3. Length 8·00; wing 5·50; tail 3·65. Predominant color brownish-gray; top of head hoary gray, with transverse instead of longitudinal black stripes. A collar, or rather patch, of white on the neck, posterior to which the fore part of breast is black mixed with yellowish. Wings cinnamon color

spotted with brownish black. Tail dark on the terminal half, the tip for only about an inch, white. Graduation of tail ·50. No filaments to the bristles of the mouth. Habitat, high central plains to the Pacific coast. *A. Nuttalli* Cass.

B. Wings very long and pointed, with a white bar across the outer primaries about midway between the carpal joint and the tip of the wings: the primaries not emarginated, the first and second equal and longest. Tail narrow and forked, with a small white bar, in the males, across all the feathers except the two central ones. Plumage rather compact. Bristles of the mouth scarcely appreciable. Partially diurnal in habits. CHORDEILES Swains.

1. Length 9·50; extent 21·50; wing 8·20; tail 4·60. Upper parts almost uniform greenish black with a mottling of yellow and ash. Under parts soiled white, transversely barred with brown. A pure white V-shaped mark on the throat commencing about a quarter of an inch behind the base of the lower mandible, the acute angle anterior, the branches curving back on each side to a point beneath and posterior to the eye. The angle of this mark is filled up with rusty tipped feathers. Wings nearly black, the upper coverts speckled with ashy. The five outer primaries with a pure white bar across them about half-way between the first joint and the end of the wing. Tail brown, with about eight transverse irregular bars of mottling, which are nearly white below, and light brownish gray above. The terminal blotch on all but the two middle feathers is white on both surfaces, larger and more quadrate, and scarcely reaches to the outer edge of the feathers. The female lacks the white throat marks, the white spots on the tail, and the wing patch is much less conspicuous. Habitat, eastern North America to Kansas. *C. popetue*, var. *popetue* Baird.
2. Similar to the preceding but much lighter. Habitat, whole of western country. *C. popetue*, var. *Henryi* Cass.
3. Length 8·40; extent 19·00; wing 7·00; tail 4·60. Above brownish black mixed with gray and rusty mottlings; the top of the head rather more uniformly brown. Nape furnished with a finely mottled collar of grayish and black. Scapulars and wing coverts finely variegated, the pattern somewhat irregular, and scarcely capable of definition A proportionally larger V-shaped white mark on the throat than in *C. popetue*. Rest of under parts dull white, transversely barred with brown, with a tinge of rufous on the abdomen and under tail coverts. Wings with round rufous spots, similar to those in the whippoorwills; the four outer primaries only with a white blotch across them, which is much nearer their tips than the carpal joint. Tail dark brown, with about eight lighter bars, the last white, extending across both vanes. The female lacks the the caudal patch. Habitat, southern portion of western North America. *C. Texensis* Lawr.

FARTHER OBSERVATIONS ON THE EMBRYOLOGY OF LIMULUS, WITH NOTES ON ITS AFFINITIES.*

BY A. S. PACKARD, JR., M.D.

In a recent paper on the "Embryology of Limulus," published in the "Memoirs of the Boston Society of Natural History," I stated

* Read at the Portland Meeting of the Amer. Assoc. Adv. Sci.

that the blastodermic skin, just before being moulted, consisted of nucleated cells, and also traced its homology with the so-called amnion of insects. I have this summer, by making transverse sections of the egg, been able to study in a still more satisfactory manner these blastodermic cells and to observe their nuclei before they become effaced during and after the blastodermic moult.

On June 17th (the egg having been laid May 27th) the peripheral blastodermic cells began to harden, and the outer layer, that destined to form the "amnion," to peel off from the primitive band beneath. The moult is accomplished by the flattened cells of the blastodermic skin hardening and peeling off from those beneath.

During this process the cells in this outer layer lose their nuclei, and, as it were, dry up, contracting and hardening during the process. This blastodermic moult is comparable with that of Apus, as I have already observed, the cells of the blastodermic skin in that animal being nucleated.

This blastodermic skin in its mode of development may also safely be compared with the "amnion" of the scorpion as described and figured by Metznikoff, and we now feel justified in unhesitatingly homologizing it with the "amnion" of insects, in which at first the blastodermic cells are nucleated, and appear like those of Limulus. Moreover the layer of germinal matter, from which the blastodermic skin moults off, may be compared with the primitive band of insects. On June 19th, in other eggs, the cells of the blastodermic skin were observed to be empty, and the nuclei had lost their fine granules, and were beginning to disappear. The walls of the cells had become ragged through contraction, and in vertical section short peripheral vertical radiating lines could be perceived.

At this time an interesting phenomenon was observed. In certain portions of the blastodermic skin, or amnion, the cells had become effaced, and transitions from the rudiments of cells to those fully formed could be seen. From this we should suppose that the retention of these cells in the amnion of Limulus is due to the singular function this skin is destined to perform, *i.e.*, to act as a vicarious chorion, the chorion itself splitting apart and falling off in consequence of the increase in size of the embryo. In insects these cells disappear, and after the skin is moulted it appears structureless.

From studies afterwards carried on in the laboratory of the

Anderson School of Natural History, on the anatomy of the adult Limulus, I have been able to fully confirm the important discovery of Prof. Owen (Lectures,) 1852 and more recently of M. Alphonse Milne-Edwards* relative to the sheathing of the nervous cord and its branches by a system of arteries, and I would here bear testimony to the accuracy of Edwards' drawings and descriptions. Moreover I have been able by a study of living Limuli, beautifully injected by Mr. Bicknell by the kind permission of Prof. Agassiz, the director of the Anderson School, to extend still farther the anatomical researches of Milne-Edwards. With Mr. Bicknell's aid I have ascertained the existence of still smaller arterial twigs, on the peripheral subcutaneous portion of the body, than indicated by Milne-Edwards, and have made out the existence of an extensive series of closed vessels in the respiratory abdominal feet. For this I was prepared by a study of the respiratory lamellæ, which, in the arrangement of their chitinous septa, may be closely homologized with the gills of Amphipod Crustacea, as observed in living specimens without injection.

With the new information afforded us by A. Milne-Edwards, regarding the relations of the nervous cord with the ventral system of arteries, and the remarkably perfect circulatory system, so much more highly developed than that of any other Arthropod, I should no longer feel warranted in associating Limulus and the Merostomata generally with the Branchiopoda, but regard them, with the Trilobites, as forming perhaps a distinct subclass of Crustacea.

Certainly if we consider the relations of the anatomical systems to the walls of the body, the disposition of the segments forming those body walls, and the nature of the appendages, Limulus is built on the crustacean type. Because its nervous cord resembles that of the scorpion, and its circulatory system is more perfect than that of any Arthropod we know, this is no reason for assuming that it is not a Crustacean. On the same ground Ceratodus is not a fish because it has the lungs of a reptile, nor is Ornithorhynchus a Saurian because it has the shoulder girdle of a Saurian.† I have, moreover, shown that some important features in the embryology of Limulus are like those of the scorpion and the hexapodous insects, the "amnion" of Limulus apparently being homologous with that of the insects.

* Recherches sur l'Anatomie des Limules. Annales des Sc. Nat., 1873.

† I have been reminded by Professor Wyman of this peculiarity in Ornithorhynchus as stated by Meckel.

In fact Limulus seems to me to be a synthetic or comprehensive type, bearing the same relations to the Crustacea that Ceratodus does among the fishes, or Archæopteryx among the birds; and because Limulus has strong analogies to the Arachnida, we should not overlook its true affinities with the Branchiopodous Crustacea.

Limulus may, then, be regarded as a Crustacean with the carapace of Apus, bearing simple and compound eyes as in that Phyllopod, with the antennæ foot-like as in many Entomostraca, and the abdominal appendages truly crustaceous in their structure, while the circulatory system is not fundamentally unlike that of other Crustacea, but only more perfect, and the digestive system is throughout comparable with that of the normal Crustacea.

ON A REMARKABLE WASP'S NEST FOUND IN A STUMP, IN MARYLAND.*

BY P. R. UHLER.

THE insects of the genus Polistes have not hitherto been reported to make nests of clay. All the North American species have been considered paper-nest-builders. Many species are known from the United States, Canada and the West Indies, and these are generally of a brown or yellow color, having spots or bands either lighter or darker.

In the present instance we have a dark brown species with narrow yellow bands across the abdomen, and with yellow feet, which builds a nest of clay in the form of a cylinder. In the stump of a decayed Liriodendron, found by O. N. Bryan, Esq., in Charles county, Maryland, a number of these insects had aggregated their cylinders. The stump was about two feet in diameter and the central cavity (which had been formed by the borings of large beetles) was five inches wide. In this, attached to the sides, sometimes lying flat in the grooves left by the beetles, or standing off at a considerable angle, and attached by their bases, were thirty-three of these peculiar structures. They were of a yellow clay, generally about half an inch in diameter, and varying in length

* Read at the Portland Meeting of the Amer. Assoc. Adv. Sci.

from two to five inches. Sixteen of these were attached in one group projecting from the side of the cavity, and towards their outer ends were bent into a blunt curve; resembling a colony of the tubes of Serpula.

The nest, or, more properly, receptacle for the egg and young, is constructed in this manner. The adult Polistes flies to an adjacent place where there is suitable wet clay, works this substance into an oval pellet and flies to the place where the building is to be made. The pellet is then laid obliquely and pressed down by the fore feet and head of the insect so as to cause it to adhere firmly to the surface on which it is building. This operation is repeated until it has formed a cylinder about one inch in length.

As it proceeds, it smooths the inside of the cylinder by working with its jaws and pushing the front of its flat head against the plastic clay. The first section being thus finished to its satisfaction it flies off to secure small spiders. It seizes a spider with its fore feet, stings it in just such a way as to paralyze, without destroying its life, and then deposits it in the bottom of the cylinder.

An egg is then laid beside the spider, and the wasp flies off to secure other spiders. This is continued until the cavity, which generally holds from twelve to fifteen of the smaller kinds, is full.

The wasp then proceeds to cover the open end with a cap of the same material as before, after which it adds other sections to the number of three or four, filling each with spiders, and depositing one egg in each. The young larva feeds on these paralyzed spiders, and, as it seems, requires from twelve to fifteen of them to nourish it until it is ready to become a pupa.

Unlike the species of Pelopæus, which also make clay nests, it does not nurse its young, but they are securely sealed up in the sections to feed themselves. When ready to come forth, the wasp gnaws a round hole in the wall of its cell, and flies forth as a perfect insect.

A similar, if not identical, species was very troublesome in Baltimore during the early part of last summer.

On the front walls of the Peabody Institute these wasps assembled in considerable numbers; and constructed their cells in the grooves of the joints of the marble. Their clay cylinders were so numerous as to greatly disfigure the marble and render it necessary to have the front of the Institute cleaned.

THE FERTILIZATION OF FLOWERS BY INSECTS AND THEIR MUTUAL ADAPTATION FOR THAT FUNCTION.*

The old idea, once a favorite topic with poets and divines, that the beauty of the external world was intended exclusively to promote the enjoyment of mankind, has suffered many severe shocks from the rude onslaughts of modern science. The discovery that the earth was a habitable and inhabited world, countless ages before man appeared upon the scene, might be explained on the hypothesis that it was thus becoming prepared for the advent of the masterpiece of creation; the egotism of the human species might even survive the discouraging fact that gems of purest ray serene were born in the unfathomed caves of Silurian or Devonian oceans, and that flowers of the most perfect beauty were born to blush unseen in the midst of oölite or cretaceous deserts. The unpitying theory of the survival of the fittest, however, points relentlessly to the conclusion that man after all is not the *raison d'être* of anything he sees around him except himself; that "jedes für sich" is the rule of nature; that every organic being is contrived so as to have the best chance of supplying its own wants, and not for the sake of administering to the wants of others; in fact that the philosophy of science must, for the future, be an application to the realms of nature of the principle of self-love, such as even a Hobbes might accept.

The volume before us, though full of minute details of empirical observation, is an important contribution to this philosophy of science. The main fact which forms the groundwork of Prof. Müller's observations is not new. Towards the close of the last century one of the keen observers of nature with which that period abounded, C. C. Sprengel, in his *Das entdeckte Geheimniss der Natur im Bau und in der Befruchtung der Blumen*, pointed out that a number of the different forms which the flowers of plants assume are obviously contrived for the purpose of attracting insects and of enabling them to carry away the pollen which is required to

* *Die Befruchtung der Blumen durch Insekten und die gegenseitigen Anpassungen Beider. Ein Beitrag zur Erkenntniss des ursächlichen Zusammenhanges in der organischen Natur.*—Von Dr. Hermann Müller. Leipzig: Engelmann.

fertilize other flowers of the same species. This line of research, which had been almost lost sight of since Sprengel's time, has been renewed in our own day by Darwin in this country, the writer of this volume and Hildebrand in Germany, Axell in Sweden, and Delpino in Italy; the first-named naturalist reducing the sum of his observations to the well-known aphorism that "nature abhors perpetual self-fertilization." The whole of that complicated structure which we call in ordinary language the "flower" of a plant consists, in fact, of the reproductive organs enclosed in a number of envelopes which have for their purpose not only the protection of the essential organs within them, but the attraction of those insects or other animals which are necessary for the fertilization of the ovules.

The contrivances for effecting this purpose, though infinite in number and variety, may be classed under two principal heads, color and scent. A large number of insects obtain their food chiefly or entirely from the juices of flowers; and the necessity for cross-fertilization renders the visits of these insects as indispensable to the life of the flower as to that of the insect. To enable them to find this food the juices are very commonly scented; a field of clover or beans will attract all the bees in the neighborhood from a great distance; and, if carefully watched, the bees will be found not only to carry off with them the honey, but to transfer also a portion of the pollen from flower to flower. Where the juice of the flower does not happen to be scented, the bright color of the corolla commonly serves the purpose of attracting insects from a distance. Different insects and other small animals have apparently very different ideas of beauty as regards the form and color of the flower. Hummingbirds are said by Delpino to have a penchant for scarlet and for flowers with long wide tubes; hence in countries where there are no hummingbirds, as our own, scarlet flowers or those with long wide tubes are very rare among native plants.* The largest-flowered of European plants, the peony and several species of convolvulus, are visited chiefly by large beetles allied to the cockchafer; and as we proceed farther north to climates too cold for this description of insect, the corresponding flowers also disappear, not being able to mature their seeds without assistance. When fertilization is effected by very

* Among our common wild flowers it would be difficult to name any of a true scarlet hue except the poppy and the little pimpernel.

small insects, something more than a large conspicuous corolla is required to show the visitors the way to the nectary or receptacle for the honey; hence arises the variegation of flowers, the bands or patterns of color being almost invariably so arranged as to direct the insect in the way it should go in search of food. As nature seldom provides two contrivances, concurrently, for the same purpose, we find that variegated (wild) flowers are seldom scented; while the most odoriferous flowers are almost always uniform in color; the evening primrose, which opens its scented flowers only in the dusk, requires no variegation to direct the night-flying moths to the scented nectar.

Illustrations of all these laws have been observed by the naturalists we have mentioned, and have been collected with great industry in this volume by Dr. Müller, himself no idle worker in the same field. According to the theory of natural selection, those descendants from a common ancestor which vary from the others in any direction that tends to increase their attractiveness to insects, or to secure a more certain transference of the fertilizing pollen from one flower to another, will have the best chance of survival and of perpetuating and increasing this peculiarity in their progeny. Dr. Müller has himself examined, or records the observations of others on, nearly four hundred species of plants, and describes the structure of the reproductive organs and of their envelopes, with especial reference to their adaptation for self-fertilization or for cross-fertilization, giving in each case a list of all the insects which have been observed to visit the flower. and illustrating his description, where necessary, by admirable woodcuts. This portion of the subject is more or less familiar to most botanists; what Dr. Müller has made peculiarly his own study is the tracing out of the same principle, applied to the visiting insects, as previous observers have noted with respect to the visited flower. By the same principle of natural selection those insects which display to the greatest perfection contrivances for extracting the honey of flowers or for carrying away the pollen — the latter serving in some cases for their own food, in others for storing up in their nests as food for the larvæ or young — will stand the best chance of perpetuating offspring provided with the same peculiarities; and we find here abundant descriptions and drawings of the various forms which these contrivances assume in different classes of insects.

In his concluding chapter Dr. Müller discusses the origin of

these phenomena, and declares himself a firm adherent of Darwin's theory, finding the explanation of every special contrivance on the one side or the other in the principle to which we have already referred. He therefore vigorously combats the teleological views of Sprengel and Delpino, the latter of whom especially, while accepting the theory of evolution or descent with modification, yet disputes the soundness, or at least the adequacy, of the other theory usually associated with it, that of natural selection. He recurs, in fact, to the pre-Darwinian doctrine of design, to account for the phenomena which furnish the subject of this work, or, as Müller represents him: "Nature is with him a being endowed with human thought, which has invented definite forms of flowers leading necessarily to cross-fertilization; and this is then completely carried out by the employment of different parts of plants for the same purpose. This creator of flowers, far exceeding in talent the cleverest man, has predestined certain forms of flowers for certain insects, and certain insects for certain forms of flowers, and has contrived each one to fit the other." The reasons which may be adduced against this theory would be simply a repetition of the main argument of Darwin's *Origin of Species* and *Variation of Animals and Plants under domestication.* The believer in the doctrine of natural selection finds it more consonant with the facts which he sees around him to assume that Nature — if it is possible to personify the idea — works, not by preconceived notions and prearranged harmonies, in which case we should expect to find everything perfect, without discord, waste, or incompleteness; but rather, as a human workman would act, tentatively; making small improvements here and slight adaptations there; every form of life, in fact, constantly approaching a more and more perfect adaptation to the circumstances in which it is placed, a perfection which, however, is never absolutely attained.

There are few regions of scientific inquiry more easily open to any observer resident in the country and possessed of ordinary powers of observation, than those connected with the fertilization of flowers, and none which would more amply repay careful research by leading to further insight into the still hidden laws which govern the origin of species. To all workers in this field Dr. Müller's elaborate and in every respect admirable work will be an indispensable companion.—A. W. BENNETT, *in the Academy.*

REVIEWS AND BOOK NOTICES.

THE HUMAN BRAIN.*—As the title indicates, the main purpose of this work is anatomical rather than physiological; for the author well says that "not the least of the obstacles in the way of solving the problem" of the relation between mental faculties and cerebral convolutions is the present "difficulty of recognizing the constant unity of form in the multiplicity of individual variations:" and he wishes his outline figures "to be regarded not so much as pictures as maps by which one may find his way more easily in this region." In other words, the four diagrams of the human brain as seen from the left side, from above, from below and from the mesial surface, must be accepted by the reader, not as accurate representations of any single brain, but as the generalized results of the author's comparison of several brains, the individual variations of which are capable of being referred to these diagrams as types.

The value of such a generalization might be estimated if the author had given us the number of individuals upon which it is based; his statement that *fœtal brains* were studied, is so far satisfactory as evidence of a correct method; but in the absence of any figures of these latter, we can test the correctness of his generalization only by comparing his diagrams with actual specimens. And without going into technical details, which would be here out of place, we must state that such a comparison with ten cerebral hemispheres, representing four different periods of fœtal life, has enabled us to confirm Ecker's views with respect to the nature of only two main outer fissures, those of Sylvius and of Rolando (*centralis*), respecting which there has never been any disagreement. We are the more willing to admit this failure to agree, because our author himself dissents from previous writers. But while insisting upon the differences from his type pattern, which are manifested by our specimens, we are firmly convinced of the futility of establishing a pattern based upon them or upon a much larger number of specimens. Indeed we hail the discrep-

* The Cerebral Convolutions of Man, represented according to original observations, especially upon their development in the fœtus. Intended for the use of physicians. By Alexander Ecker of Freiburg (1869). Translated by Robert T. Edes, M. D. 1873. 8vo. pp. 87. $1.25.

ancy as another proof of three views elsewhere urged by us; 1. That a *very large* number of specimens especially of fœtal brains, must be carefully studied. 2. That the results must be checked by an equally careful comparison between the *two halves of the same brain.* 3. That the existing disagreement is likely to persist for a long time unless we discard the human brain for the simpler brains of the lower monkeys, the lemurs and *carnivora*, using large numbers of brains of *nearly allied* species. But the foregoing considerations do not hinder our acknowledgment that the present work is a real boon to anatomical science; since it for the first time renders it possible, for the reader of English only, to ascertain what has been done in cerebral topography; the figures are clear, the nomenclature uniform, and a full synonymy is prefixed to the description of each fissure and fold.

The fissures, are, correctly as we think, stated to be the "more important," but upon what ground is not indicated; and there is given a brief account of the formation of the Sylvian fissure, as differing from all others: a point which has been in part confirmed by our own observations upon the brains of young animals.

We are now inclined to return to the ancient belief that each cerebral hemisphere acts as a unit and with more or less vigor according to the number and depth of the fissures; but Ecker vigorously repudiates this idea, holding that it "consists of a multitude of organs each of which subserves definite intellectual processes." But this opinion, while according with the original idea of phrenology, by no means indicates our author's estimate of the present "professors" of that "science" to whom, together with the rest of this admirable little work, we cordially recommend the following passage (p. 9). "The travelling phrenologists, who wander around with plaster heads of Schiller, Napoleon and some celebrated rascals, and cipher out a character from a number of bumps on the skull, are well known. Few of them have ever seen a brain."—BURT G. WILDER.

INFUSORIAL LIFE.*—Under this title Mr. W. H. Dallinger and Dr. J. Drysdale publish, jointly, in the August No. of the "Monthly Microscopical Journal," an article of extreme interest as a natural history contribution, and of revolutionary importance

* Researches on the Life History of a Cercomonad: a Lesson in Biogenesis.

in respect to the prevalent methods of investigating questions of "spontaneous generation." Dissatisfied, as most thinkers are, with the vague and uncertain methods and conclusions of heated infusions and sealed flasks, the authors turned for an answer to the life history of the individual monads, and fortunately succeeded in obtaining the history of a species which might easily have been described as a group of species or quoted as an organism of spontaneous origin.

The necessity for a change in the methods of study in biogenesis is well stated in their words, as follows:—"The question as to whether vital forms of the lowliest and minutest kind may have their origin in a new, and as yet unexplained, arrangement of non-vital material, is one that can never find a legitimate and final reply in the class of experiments employed to test it within the last thirty years. A careful student of the literature of the subject will see that the *results* obtained by the same and different experimenters, with similar infusions and solutions, are so uncertain, and often contradictory, as to leave the whole question open to bias; and an almost equal array of so-called 'experimental facts' from nearly equally trustworthy observers, may be quoted on either side. This may be all pleasant enough in a 'wordy war,' but it does not even approximate to a decision of the issue, and points to insufficiency in the experiments employed. The appearance or non-appearance of organic forms in certain infusions placed in sealed flasks or tubes, or otherwise conditioned, is held to be decisive of their production *de novo* or otherwise; but in point of fact we know *nothing*—absolutely nothing—of the life history of the greater number of the forms produced. To attempt to decide, therefore, from the experiments as yet published, that their production in gross masses in inorganic infusions proves that inorganic elements produced them, may be to beg the whole question. Inferring from what we *know* of nature's modes of reproduction, we have a right to expect, not a *de novo* production, but a production from genetic elements. But when we remember the relation in size, throughout nature, between the ova and spermatozoa and the organism producing them, the fact that no such elements are visible (if they exist) in Bacteria or monads is probably a mere necessity of our present instrumental power. At least this is inevitable, that before we can be scientifically certain that these lowly forms do or do not originate in non-vital

elements, we ought to know their life-history; and if this be desirable in the question of abiogenesis, it must be absolutely essential before we can even approach that of heterogenesis. We must patiently follow them without a break in observation, through all their changes, and then, by repeating these observations, decide on the stability or otherwise of the form. For some years our attention has been individually directed to this subject; and three years since the advisability of combined work commended itself to us. For work of this kind to be effective, we believe there must be more than one observer, in order that the observations may be unbroken as far as possible, and also to secure a mutual as well as a double confirmation."

With Ross' medium powers, and Powell and Lealand's high ones, the authors commenced the study of an undescribed monad which sometimes occurs abundantly in water in which a cod's head has been macerated. The drop of infusion was so arranged that it could be preserved in the focus of the highest powers, and the organisms inhabiting it maintained alive and healthy, and under continuous observation for an indefinite length of time.

The cercomonad subjected to study was a small oval body with two actively moving flagella at one end. This was the familiar, mature form, and the one which, alone, according to the usage of the students of Infusoria, would be considered characteristic of the species. Other forms however were observed, differing in size and shape and with one flagellum at each end, or amœboid with or without flagella, or cyst-like and smooth and globular; forms each of which might easily be regarded as a distinct species or possibly as a capricious variety, but which were tracked through a series of transitions, the recurrence of which was repeatedly observed and was found to be unvarying and to be a portion of the life history of the same individual. The mature form with oval body and two flagella at one end, after moving about with great activity for a period of time which in the observed cases was about forty minutes, became squarer or more elongated, and somewhat dumb-bell shaped by a sudden constriction of the sarcode. At this stage the body is furnished with one flagellum at each end, which lashes with great force. The constricted portion becomes narrowed more and more by stretching until so attenuated as to equal only the flagella in thickness, when it parts in the middle, leaving two separate bodies each furnished with a flagellum at each end.

This multiplication by fission, in an average of forty cases, was completed in four minutes and forty seconds, and continued to be repeated without variation during from two to eight days.

After this period the organism gradually assumes an amœboid form by pouring out a delicate sarcode, and moves only by pseudopodia although the flagella are still present and somewhat active. In the course of seven hours, there were several of these amœboid forms in the field, each enclosing or enveloping a flagellated body. Finally two of these approached each other until they touched, and rapid blending of the sarcode took place, the flagella disappeared, the bodies came in contact with each other and rapidly coalesced, and the common body thus formed increased in size until it was no longer enveloped in the delicate sarcode, but became a mere, smooth, globular cyst with a distinct integument which afterwards became thin, burst, and discharged a viscid mass of oily looking matter. Under the power employed, Powell and Lealand $\frac{1}{50}$ and A ocular ($\times$ 2500), this presented, when somewhat dispersed, a minutely granulated appearance. By adding an eight inch drawtube and B ocular, it became certain that this consisted of a densely packed mass of inconceivably small granules. The observers believe that they should have wholly failed to see these sporules but for their enormous aggregation and motion in a mass, and that "*with the $\frac{1}{25}$ the most accurate observer could not have discovered their presence if he had not previously seen them with the* $\frac{1}{50}$."

The development of these granules was now watched with the greatest care. In six hours they had increased to a decidedly perceptible degree, though still far smaller than the minute and familiar *Bacterium termo* of Cohn; an hour or two later they began to reassume an oval shape; in nine hours from the first they had become rather larger than *B. termo* and had become flagellate and begun to move freely, the bodies became vacuolate, and in something less than twelve hours the normal parent form was assumed. This history was traced carefully and repeatedly, and with unvarying results.

The effects of heat and dessication were also tried; and it was found that although drying slowly upon a glass slide and exposure to a dry heat of 121° C. entirely destroyed all the adult forms, yet, after moistening again with distilled water and watching the field for some hours, growing points were in some instances dis-

covered exactly resembling an early stage of the developing sporules, which points matured into the flagellate state. Farther experiments demonstrated that a heat, without dryness, of 66° C. destroys all the adult forms, while young monads appear and develop in an infusion which has been heated to 127° C., suggesting that the *sporules are uninjured by a temperature which is destructive to the adult.*

After this history, whose importance, if verified by subsequent observation, can scarcely be over-estimated, a history of a monad multiplying by subdivision, reproducing by conjugation (a true sexual reproduction of an extremely simple type), and actually seen to develop from sporules invisible under the powers usually employed in such investigations, and indestructible by heat which is fatal to the adult forms, it seems almost a waste of time to read of experiments with boiled infusions in sealed flasks, and we are rather inclined to wait patiently until Powell and Lealand or Tolles, or some one else, shall give us a lens capable of reading the life-history, whatever it may be, of Bacteria and Vibriones.— R. H. W.

BOTANY.

PERFORATION OF GERARDIA PEDICULARIA BY BEES.— I have always been much interested in the pretty genus Gerardia, largely represented in the vicinity of Providence, R. I. In the summer of 1871, while sitting amidst a dense growth of *G. pedicularia*, I noticed that all the humble-bees which visited the flowers alighted on the outside near the base of the corolla. I could not account for so singular an action, as the aperture to each bell was so wide. I found upon examination that the corolla in each case was pierced on the upper side near the junction with the calyx. I sent a note in regard to the matter to W. H. Leggett, Esq., of New York, and it appeared in the "Bulletin of the Torrey Club." The editor remarked that it was the first case, in his knowledge, of our native flowers being slit in this manner by visiting insects.

Not satisfied with what I then saw, I have watched the plants again this year with much attention, often sitting among them for an hour or more with the bees buzzing about my head. I should say that they were all humble bees, and I have seen but one of them approach the natural opening of the flowers. This was a much larger bee than any of the others. None of them had

their legs dusted with pollen. On one occasion I saw a small metallic green and iridescent bee among the flowers, but could not observe whether he entered them. The sweet odor of the flower is very heavy and oppressive.

Why should these insects perforate the corolla when the flower is apparently so easy of access in the usual way? Examination of the structure does not throw much light upon the matter. The corolla is bell-shaped and of funnel form. There are four stamens, two long and two short, the filaments clothed with hairs, which are probably bathed with nectar, as the perforation is made just above them. The anthers are two-celled, approaching by pairs, and each cell has a sharp cusp at the bottom, pointing inwards. The style is long, and the stigma is bent over the longer stamens. I find, upon inserting a pencil into the mouth of the flower, that, upon retracting it, it is brought in contact with the cusps above referred to, which causes the anther cells to expand and discharge the pollen copiously. An insect acting in the same way would have its back dusted, and when visiting another flower, would necessarily rub off a portion of the burden upon the stigma. I thought the sharp cusps might tickle or prick any intruder and thus compel him to retreat. Dr. Gray, however, does not consider these projections sharp enough to annoy the bee, and moreover considers it improbable that the flower would be provided with a contrivance so manifestly to its disadvantage. There are "guiding lines" of orange dots leading towards the nectariferous hairs.

I have seen bees approach the front for a moment and then retire as if baffled. Most of them, however, begin operations at the back at once. They alight with the tail towards the open end of the flower and at once insert the head into the little hole. I have never seen them make the aperture, although it is difficult to find a blossom without one. Even the buds are often penetrated; out of a large number of flowers plucked at random from different plants in different localities, I cannot find one flower without the slit. I have got others to observe for me with the same result. It is a constant pleasure to watch the curious action of these bees.—W. W. Bailey.

The Connecticut Valley Botanical Society held its first annual meeting at Amherst, Mass., Oct. 1. This new Society was organized in June last, mainly through the efforts of Mrs. Maria

L. Owen, of Springfield, Mass., and begins with a membership of about twenty ladies and gentlemen.—*President*, Prof. C. H. Hitchcock, Hanover, N. H.; *Vice President*, Rev. H. G. Jesup, Amherst, Mass.; *Secretary*, Mrs. M. L. Owen, Springfield, Mass.

Various papers of interest were presented at the meeting by the President and other members; an account of recent explorations near the head waters of the Connecticut river was given by one who had just returned from that region; a number of rare plants were exhibited; and work was planned for the coming year which promises valuable results. The society bespeaks the sympathy and coöperation of all the working botanists throughout the valley of the Connecticut river.—H. G. J.

HERBARIUM PAPER.—The Naturalists' Agency purpose keeping herbarium paper for sale, in small quantities, and taking orders for it in larger quantities; both the white sheets for species, and genus covers, such as are used at the Gray Herbarium of Harvard University and by most of the principal botanists of the United States. Botanists and institutions now sending their orders for the white paper, for two reams or more, may be supplied at $5 per ream (unless the price of paper should meanwhile rise). Those who order after the first lot of paper is made will probably have to pay a higher price, as also will those who buy less than whole reams. The species paper sheets are 16⅜ × 11½ inches. Orders may also be sent for genus-covers. These are of Manilla paper, very thick, 16½ × 24 inches, *i.e.* a foot wide when folded. The price will depend somewhat upon the extent of the orders received, but will probably be about $7 a ream. Orders should be sent without delay to the Naturalists' Agency, Salem, Mass.

LITHOSPERMUM LONGIFLORUM ONLY L. ANGUSTIFOLIUM.—While collecting specimens of *Lithospermum longiflorum* Spreng., in fruit, I noticed that the plants were still producing *small* flowers. A gradual reduction could be easily traced, from the conspicuous early inflorescence of the erect stem, to the small corolla scarcely exceeding the calyx, borne by spreading branches later in the season. This summer state of the plant is clearly *L. angustifolium* Michx.! within the limits of our familiar flora of the northern states, therefore, we have not only two species, founded upon different periods of growth of the same plant, but one of these has even been separated from *Lithospermum* and made the type of a

distinct genus, *Pentalophus* A. De C. It is a pity to lose the appropriate name of *longiflorum* but it must yield to the older one imposed by Michaux.—M. S. Bebb.

Rhexia Virginica L.—This species produces fusiform tubers and of course grows from them the following year. In the few books accessible to me here (Wethersfield, Conn.), "Gray's Manual," "Chapman's Flora S. U. S.," "Benth. and Hook. Gen. Pl.," no mention is made of this character of genus or species. Hence, I infer it is not generally known. Will botanists who can readily examine other species observe whether or not it is a generic character and let us know?—C. W.

Cleistogenous Flowers are produced late in the season, and almost exclusively by *Oxybaphus nyctagineus*, as observed by H. W. Patterson, of Oquawka, Illinois. In *Nyctaginia capitata*, of Texas, as cultivated in the botanic garden here several years ago, we noticed the opposite of this, *i.e.*, all the earlier flowers were cleistogenous.—A. G.

ZOOLOGY.

Notes on some of the Rarer Birds of New England.—The occurrence in New England of the birds here mentioned, and the nesting therein of many of them, will perhaps be of interest to some readers of the Naturalist:—

An ornithological friend, Mr. J. N. Clark, residing at Saybrook, Ct., writes me that the following species are found in numbers, and breed regularly, in that locality: *Icteria virens*, *Helminthophaga pina*, *Myiodioctes mitratus*, *Icterus spurius*, *Ammodromus maritimus*, *Myiarchus crinitus* and *Rallus crepitans*. He also observes in the nesting season *Helmitherus vermivorus*, but as yet has failed to find the nest. *Melanerpes erythrocephalus* also breeds, and a number remained with him all through last winter. Most of the above have usually been regarded only as rare and accidental visitors to the southern portions of New England, and the others as found but sparingly and locally in any section of it. The fact of the *blue-winged*, *yellow*, *worm-eating* and *hooded warblers* occurring constantly is, I think, of special interest. He sends me a specimen of *Seiurus Noveboracensis* and says, "I can testify that about the period of nesting they are most extraordinary singers." I think it possible, however, that the bird actually nesting with him

may be *Ludovicianus*. The shooting of the latter and finding its nest and eggs at Norwich, Ct., by Mr. E. Ingersoll, make the theory tenable.

One instance of the nesting of *Mimus polyglottus* has come to his knowledge. *Cathartes aura* and *Garzetta candidissima* he has seen rarely and has *heard* of *Cardinalis Virginianus*. All through the winter of 1872–73, *Sialia sialis*, *Dendrœca coronata* and *Melothrus pecoris* remained in flocks. The worm-eating warbler he finds in thickets on the edges of swamps,—a restless bird with a very strange, loud, rattling call; at other times he remarked a warbling song reminding him of that of the common goldfinch, only a little softer. *Sphyrapicus varius* is abundant in fall. He considers *Ammodromus maritimus* as being much more plentiful than *caudacutus*. His observations of *Oporornis agilis* are the same as those of Massachusetts collectors. It occurs only in the fall (September). My correspondent has kindly sent me specimens in the flesh, and nests and eggs of many of the above species in confirmation of what he has written me. No part of New England has been embraced within the Carolinian fauna, and properly so, but that its southern border has a tinge of it, is quite evident.

In this connection I will state that several *Melanerpes erythrocephalus* have been shot in eastern Massachusetts within about a year in both the adult and immature plumage. Two *Picoides arcticus*, both males, were shot in Middlesex county, late in the fall of 1871. A nest and eggs of *Icteria virens* were found near Lynn last June, the fourth nest of this bird that my informer has found in that locality. A fine specimen of *Herodias egretta* was killed in Westford; *Limosa Hudsonica* has been quite common along the coast this fall; a *Porzana Noveboracensis* was shot on Canton marshes, Oct. 15, 1872; a *Histrionicus torquatus* at Hampton, N. H., Nov., 1872; and two or three young *Sterna Forsterii* have been obtained on our coast within a year.—H. A. Purdie, *West Newton, Mass., Sept.*, 1873.

On the Migration of Certain Animals as Influenced by Civilization.—During the autumn of 1850, I emigrated to the state of Wisconsin and settled upon what was known as the "Indian Lands," situated in the central part of the state, north of Fox River. The Indians were not removed, and very few white settlements had been made. The forests abounded in the usual

variety of wild animals including the deer, gray wolf and black bear.

As the entire fauna and flora seemed to be unchanged, a good opportunity was afforded for observing the influence of advancing civilization. Many interesting facts were observed in regard to both plants and animals, some of which may be of importance as illustrating the habits of certain species.

During the first winter, the raven (*Corvus corax*) was frequently seen, sometimes solitary, but more frequently in flocks of from eight to ten in number, flying along the watercourses or hovering over thickets into which a wounded deer had been chased. They were less frequently seen during the summer, probably going north to their breeding place, as no nests were ever found in that section. The country lying north and northwest was almost one unbroken wilderness to Lake Superior, while the southern boundary was formed by the Fox river at a distance varying from twenty to thirty miles.

During the following season a larger number of settlements were made, while the Indians were gradually removed. The ravens returned for two or three following seasons, though in diminished numbers. During this whole period, as far as I am able to learn, not a single specimen of the common crow (*Corvus Americana*) was seen or heard in the whole region. While he was a resident of the southern and eastern parts of the state, he seems to have carefully avoided the Indian lands. It was not till more than a year after the disappearance of the raven that the first crow, a single straggler, appeared, uttering his well known "caw," advancing northward evidently on a tour of exploration. He seems to have carried back a favorable report, for soon others appeared, and in a short time the species became very common.

Several interesting inquiries arise in relation to the habits of these animals. Do they ever exist together, or is there any antagonism between the species? Although the distance was not more than twenty miles to Fox river, the southern boundary of these lands, the raven was not known to advance farther south, nor the crow to visit the lands occupied by the former. Whether the raven is now found within the limits of the state I am unable to determine.

Dr. Coues in his "Key to North American Birds" gives the habitat of the raven "North America; but now rare in the United

States east of the Mississippi, and altogether wanting in most of the states. Very abundant in the West, there supplanting the crows." In the present case it would seem that the raven preoccupied the ground, *excluding* rather than supplanting the other species. The disappearance of the raven could not be owing to the wholesale and wanton slaughter so often practised by settlers upon the animals occupying the lands upon which they locate, for it was seldom that a specimen was shot. They were regarded as quite inoffensive, never being known to commit any depredations upon grain fields, and were allowed to range unmolested. It is quite probable their departure was owing to the increasing number of settlers, the opening up of fields, and other changes incident to new settlements.

Another example of the migration and succession of species was that of the four-lined squirrel (*Tamias quadrivittatus*). This sprightly little animal was very common, being seen everywhere through the forests and around settlements, while not a single specimen of the common striped squirrels or chipmunk (*Tamias striatus*) appeared anywhere in the region.

Other species of squirrels were very common, the red fox, gray and black squirrels, and especially that pest of farmers, the striped gopher (*Spermophilus lineatus*), were everywhere abundant. I well remember the first specimen of a chipmunk which I saw after two or three years residence in that section. I met him about five miles in the direction of Fox river on his emigrating tour northward. He had taken up his temporary residence under the roots of an old stump, on the top of which he was perched uttering his characteristic "chip" a note which the other species never produce. He was soon followed by numerous others and the two species lived together for a while, as far as I could observe, without any discord. The four-lined squirrels, however, soon became less numerous and in a short time were so scarce that it was difficult to obtain specimens and they have long since entirely disappeared from that region.—Moses Barrett, M. D., *Milwaukee, Wisconsin.*

Notes on Two little-known Birds of the United States. —Baird's bunting (*Centronyx Bairdii*) is the most abundant and characteristic species along the northern border of Dakota, between the Pembina and Turtle Mountains—in some places out-

numbering all the other birds together. It is surprising that so common a bird should have resisted research, as this one has, for thirty years. Its history is somewhat peculiar. Discovered by Audubon on the Yellowstone, in 1843, the original specimen, still preserved in the Smithsonian, has remained unique until the present year. It was described and figured by Audubon (Birds of America, vii, p. 359, pl. 500) under the name of *Emberiza Bairdii*, and in 1858 was made the subject of an elaborate article by Prof. Baird, who instituted for its reception the genus *Centronyx*. This name, however, is scarcely tenable, the structural peculiarities being so slight that the bird might very properly stand as *Passerculus Bairdii*, if the original generic designation be considered too broad for present use. (The species is so much like a savanna sparrow that it was some days before I learned to tell the two apart, at gunshot range, often shooting one by mistake for the other.) The literature of the subject rested mainly on these two articles until 1869, when "*Centronyx Bairdii*" came again on the *tapis*, through the announcement of its discovery in Massachusetts (see Maynard, Am. Nat., iii, 1869, p. 554, and Nat. Guide, p. 112: see also Allen, Am. Nat., iii, p. 631, and Brewster, Am. Nat., vi, 1872, p. 307). This, however, was a mistake: the supposed *Centronyx* proving to be a *Passerculus*, believed by Mr. Maynard to be new, and by him afterwards named *P. princeps* (Am. Nat. vi, 1872, p. 637; see also Coues, "Key," pp. 135, 352). In noticing these points last year, in the "Key," as just quoted, I rather cast suspicion upon the true species itself, by venturing upon the gratuitous presumption that a second specimen of *Centronyx* would never be found. This was decidedly the greater blunder of the two — to tell how I happened to be led into it would not interest the general reader. So matters stood till this year, when Mr. C. E. Aiken took, in Colorado, a *Centronyx* which was considered to be a second new species of that genus, and was published as such under the name of *C. ochrocephalus* (Am. Nat., vii, 1873, p. 237). The writer of the article in question takes pains to point out certain slight discrepancies in size and form between the type specimen of *C. Bairdii* and the single specimen of the supposed new species, and lays particular stress upon a difference in the coloration of the heads of the two. Now I have not yet seen the new bird, and will not risk the chances of being twice mistaken about one species; but this is certain: that the ascribed specific charac-

ters fall entirely within the normal limits of individual variation in this or any other one of our sparrows.* My specimens of Baird's bunting, over fifty in number, including both sexes, all ages from the nest upward, and various changeable states of plumage, run from 5·10 to 5·85 in length, by 9·10 to 9·90 in extent, and show variations to match in other dimensions and proportions of parts. As to color, they range from some with the head-stripe only faintly buffy-gray, to others with this part rich golden brown (just as in the golden-crowned thrush) and the rest of the head suffused with the same color; these extremes shading insensibly into each other. Some of the youngest specimens differ still more from the adults; being in a plumage hitherto unknown, and one so decidedly peculiar that under other circumstances of capture they might not have been referred to *Centronyx* at all. I shall take another occasion to complete the biography of *Passerculus Bairdii* respecting which my notes are now quite full.

Next to Baird's bunting the Missouri skylark (*Anthus Spraguei*) is one of the commonest birds which breed on the prairie region above indicated, about equalling in abundance the chestnut-collared bunting (*Plectrophanes ornatus*). It is another example of the curious fact that a very abundant bird, and one inhabiting no inaccessible region, may by mere accident remain for years almost unknown. Of this species, introduced to us under the same circumstances as those attending the discovery of Baird's bunting, I never, until this season, saw but two prepared specimens; Audubon's type, and one other, taken on the Saskatchewan by Capt. Blakiston, both in the Smithsonian. Another taken at Fort Randall, Dakota, by Capt. J. P. McCown, is said to be in Mr. Lawrence's cabinet. I am satisfied that I saw the bird myself at Fort Randall early last spring, but I can show no specimen to vouch for the statement. This summer, however, I have collected a large number, at various points along the 49th parallel. Among them are some nestlings just ready to fly, in a very pretty plumage materially different from that of the adults. Others show the transition toward the mature state. Fresh measurements of adult individuals exceed some that have been recorded in my work and elsewhere; the length being up to 6·50, the extent to 11·00, the wing to 3·30; an average is about 6·25×10·60×3·20.—E. COUES.

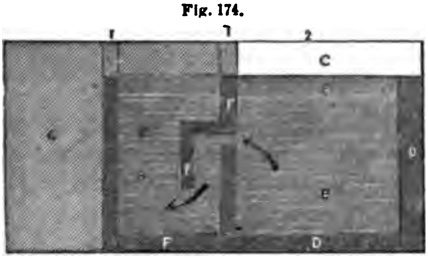
*Information received from Prof. Baird since the above was written confirms my impression that *C. ochrocephalus* is the same species, in autumnal plumage.

MICROSCOPY.

A New Growing-cell.— Having lately had occasion to examine some minute forms of life, and finding that, from some cause or other, most of the growing cells failed to work well continuously, I made a growing-cell similar to the following sketch, which I trust some readers will find useful.

Cut two pieces of moderately thick crown glass, one 3 inches by 1½ inches, the other 1¾ inches by 1½ inches, cement these together with Canada balsam; when dry. fix with the same cement two slips of glass of the same thickness to the other end of the slip, so as to form the sides of the reservoir (D D); also fix with gold-size slips of thin glass, so as to form the sides of the growing-cell (F F F F); when quite dry, cement a piece of thin glass 2¼ inches by 1¼ inches over all—care being taken that a very small quantity of gold-size is used, or it will run into the growing-cell. When used, fill the reservoir with fresh water until it runs into growing-cell A, and both are at the same level. The object (the growth of which it is desired to observe) may then be placed in the cell. If made of these dimensions, the water in the reservoir B will continue to supply fresh water to the growing-cell for at least three days without being refilled; of course, if the reservoir is made larger, it will last longer than this.

Fig. 174.



References to illustration: A, growing-cell; B, reservoir fresh water; C, glass slip 3 inches by 1½ inches; D, side of reservoir; E, thin glass 2¼ inches by 1¼ inches; F, sides of growing-cell; G, growing object.—Jno. H. Martin, *Micro. Assay Laboratory, Maidstone, England.*

Revival of Animalcules after Desiccation.— Mr. Henry Davis discusses this old and curious question in a recent contribution to the Royal Microscopical Society. He finds that Pritchard and Carpenter and nearly all modern scientific writers have aban-

doned the doubts raised by Ehrenberg and others, and believe in the revivification of rotifers, tardigrades, etc., after complete and unlimited desiccation. His own experience with a colony of rotifers which he received by post in a few grains of dry, dusty powder, and almost immediately brought to life by watering it in a stage-tank, was suggestive, certainly, of wonderful powers of endurance. He narrates the history of this colony as follows:—

"Since its establishment in 1867, it has received no new immigrants, but as it increased and multiplied, some of its members, in a dry state, have been removed to stock new tanks for my friends. It is generally kept in a cabinet, with other objects, and watered for examination when required, or, as a rule, once a month; so small a quantity of water dries up rapidly in summer; in a day sometimes. The longest time it has kept continuously dry is ten months; in winter, after watering, it has been frozen into a mass of ice; it has been heated on a brass mounting-table, with a spirit lamp very often, in order to melt the marine glue when a new cover has been required; it has been exposed dry to the sun in a photographer's glass room, all through a broiling summer; taken a sea voyage to the south of Spain, revived there and brought home again; taken to Ceylon; to India; revived on ship-board, to the astonishment of the passengers; brought home, and a few of the dry inhabitants immediately posted off again to a friend in Ceylon, who revived and has them still. As a final indignity and injury this much enduring family has been put into the receiver of an air-pump for twelve hours and thoroughly exhausted. This was almost too much for it, but still there is a little life in the tank."

Experimenting on this subject, he found that, while some could survive a short exposure to a heat of 200° (Fahr.), a thorough baking or boiling for two or three hours killed them all. Drying for a week in an exhausted receiver along with sulphuric acid was also fatal. He admits proof of revival after four years' torpor; though he failed in experiments extending over only from one to three years. Though nearly all authorities agree in the books as to the desiccation theory, yet many good observers privately doubt whether those that revive were really dried at all; and Mr. Davis is satisfied that the non-revivers are the dried ones, and those which revive do so because they were not desiccated. He has observed that the creatures constantly give off a slimy secretion; and in drying they contract into an ovoid form, and the gelatinous fluid dries over them into a thin hard shell which protects them from further drying. If isolated rotifers are dried upon a clean glass

slide they seldom revive; because they crawl about until the last moment, and thus part with so much of their protective covering that they are finally dried up and destroyed.

Notwithstanding the first impression of some of the Fellows of the Society, that Mr. Davis' researches had been entirely anticipated by many continental authorities, the doctrine of the gelatinous envelope seems to be an entirely original as well as a very satisfactory settlement of a much disputed question.

ACTION OF POISONS ON THE BLOOD CORPUSCLES.—Dr. Osler read a paper before the Medical Microscopical Society, in London, giving the results of his experiments on the action of solutions of the sulphates of atropa and of physostegia upon the blood corpuscles. He hoped to show, in the corpuscles, the already demonstrated antagonism between these reagents, but reached an exactly opposite result, both solutions checking in a somewhat similar manner the amœboid movements of the white corpuscles, and both causing the red corpuscles to become irregular from involutions and cuppings of the surface. The reagents mixed produced the same changes as when separately applied. Solutions of curare were also mixed with blood, but produced no positive results.

LIMIT OF RESOLVING POWER. — How little we appreciate the extent to which the resolving power of our best objectives falls below the possibilities of their amplifying power, was well illustrated by the surprise of many microscopists, and the incredulity of some, when Nobert's 19th band, of 112,000 lines to the inch, was beautifully resolved by a power of scarcely over two hundred diameters; while, with absolutely faultless definition, the same lines ought to be visible under a much lower power than that. What we ought, theoretically, to be able to see with powers of from one to three thousand diameters, is computed in the following curious extract from one of Dr. Pigott's recent papers.

"With regard to these minute quantities [beading one hundred thousandth of an inch in diameter, etc.], and to remove doubts which may arise in some persons' minds as to the possibility of seeing such very minute linear quantities, I may say that a minute of arc corresponds to the breadth of the 334th part of an inch as seen at ten inches, which is at least four times as thick as a human hair at that distance. Now the one hundred thousandth of an inch under a power of 1,000 is precisely the same thing as a thous-

andth of an inch under a power of one, or seen naturally at ten inches. But we can see hairs much finer than this — say three times — therefore, with regard to arc, we can see with a power of 1,000 the $\frac{1}{3}$ of $\frac{1}{100000}$, *i.e.*, with a power of 3,000 about the millionth. To find the angle in seconds, $1'' = 0.000004848 = \frac{5}{1000000}$, nearly.

$$\left.\begin{array}{l}\text{The angle under a power of 3,000, at}\\ \quad\text{a distance of ten inches, is for a}\\ \quad\text{millionth of an inch. . . . .}\end{array}\right\} = \frac{3.000}{10 \times 1000000} = \frac{3}{10000}$$

Divide this by the value of one second and we get six seconds in the angle subtended by $\frac{1}{1000000}$ under a power of 3,000."

USE OF MICRO-PHOTOGRAPHS.—The experience of the late siege of Paris has given a permanent prominence to microphotography as a practically useful art. A French engineer now proposes to reduce messages photographically to microscopic size, and then blow them through a pneumatic tube under the straits of Dover to England, where they should be raised by photography to a legible size again. Thus the promptness of the telegraph would be approached, while its expensiveness, in the case of long messages, would be avoided.

STRUCTURE OF DIATOMS.—In stating Mr. Stodder's disbelief that the silicious matter in diatoms was always deposited in spherules, we omitted to explain that it was the processes, or so-called feet, of *E. Argus* which he considered structureless. Mr. Stodder also desires us to notice that he does not adopt Mr. Slack's term "ordinary diatoms;" that he has not believed the markings on all diatoms to be depressions, but that the dark spots seen by reflected light on *E. Argus* are so; and that he and Mr. Wells have not been associated in studying this subject. He also contributes the following remarks in regard to test objects and high powers.

"The histologists, vegetable and animal anatomists may say as they have said, 'What of it? Is it worth the time and labor required to determine whether the minute granule of one fifty thousandth of an inch is hexagonal or circular, a bead or a cavity?' Yes, gentlemen, it is, for so long as these questions are unsettled, so long must you be uncertain of the true interpretation of your own observations; so long as you do not use the best instruments and the highest powers, so long must you be ignorant of

the undiscovered, uncertain whether you have found all that can be found. No better tests are yet known of the quality of microscope lenses than the diatoms and Nobert's lines. To know that you have obtained the best results in your own specialties you must know what your instruments can do on known objects; to 'increase knowledge' in your own departments, you must use the best instruments and the highest powers the skill of the optician can produce. Science cannot be much advanced by the use of lenses of twenty years ago."

METHODS OF STUDY IN INFUSORIA.—An abstract of an extremely suggestive paper relative to this subject is given under "Reviews" in this number of the NATURALIST.

CORRECTION TO NOTE ON APERTURE.—"Improved assumption" p. 567, line 1, should have been printed "unproved assumption."

NOTES.

THE Kansas Academy of Science held its sixth annual meeting at Lawrence, Kansas, on Sept 11 and 12. This Academy holds its annual meeting of two or three days duration in different places in the state. Papers are read on various subjects, and considerable work is done for the encouragement of science throughout Kansas. Quite a number of papers were read, and a special address was delivered which was anti-Darwinian in character. Among the papers falling in our sphere for notice, was one by Prof. F. H. Snow on "Injurious Insects," and one by Prof. B. F. Mudge on the "Discovery of Fossil Footprints in Osage County," of "middle permian" age. Several hundred tracks were collected and will be sent to Prof. Marsh at New Haven. Another paper by Prof. Mudge was on the "Mound Builders." The evidences of this ancient race in Kansas consisted in finding deposits of pottery, indicating ancient villages, but we do not note anything in the description of the remains that prove them to be those of mound builders any more than of Indians of more recent date. No mounds are mentioned, and, until the pottery found has been carefully compared with that unquestionably made by the mound builders and the Indians, the particular race whose remains are described must be left in doubt. The following is the most interesting part of the paper as reported:—

"But the most important locality seen by us in Kansas lies not

far from Asher creek, on the southwesterly side of the Solomon river, in Cloud county. The locality is on a rolling prairie, just above the river bottom, which is here quite narrow. The most marked feature of this village is the pottery, where their domestic articles were manufactured. It covers an area of from one-fourth to half an acre, rising irregularly at the highest point about two feet above the level of the adjoining prairie, and is composed to a great extent of the materials and debris from the old workshops. In it we found a considerable quantity of the clay, dug from the banks of an adjoining ravine, which had never been moulded; and some partly moulded and sometimes mixed with straw, probably to be used in the coarsest articles. Also fragments from what appeared to be the ovens in which the pottery had been baked. These fragments showed marks of fire, and were too clumsy and coarse to have been part of any household utensils, and were mostly in a heap in the highest and central part of the village. The extent of the village was obscure, as the rank grass had covered the ground for long ages and nearly obliterated all traces of what once existed."

The next meeting will be held at Topeka, in Sept., 1874. Prof. Snow was elected president, Prof. Fraser retiring from the chair.

THE first award of the Grand Walker prize of $1,000 was voted by the Council of the Boston Society of Natural History, on Oct. 1, to Mr. Alexander Agassiz of Cambridge, for investigations on the embryology, structure and geographical distribution of the Radiates, and especially on the Echinoderms, and the publication of the results as embodied in his recent work.

The Annual Walker prize, for 1873, of $60, was, at the same meeting, awarded to A. S. Packard, Jr., for his essay on the development of the common house fly.

A VERY deserving institution has recently been established in Cincinnati, under the title of the Cincinnati Acclimatization Society, its object being to effect the introduction of such foreign birds as are worthy of note for their song or their services to the farmer or horticulturist. The society announces that during last spring it expended $5,000 in introducing fifteen additional species of birds, and that it has already successfully accomplished the acclimatization of the European skylark, which is stated to be now a prominent feature of the summer landscape in the vicinity of Cincinnati. Among the species which it is proposed to introduce is the European titmouse, considered abroad as one of the most successful foes of insects injurious to vegetation.—*Nature.*

PROFESSOR MARSH's exploring party returned to Fort Bridger, Wyoming, Sept. 5th, after a most successful trip of six weeks, among the Eocene fossils of the Uintah mountain region. Many interesting discoveries were made, especially of new mammals, birds and reptiles. The party are now at work in Oregon, and will return east in December.

ANSWERS TO CORRESPONDENTS.

C. M., Mass.—The objects sent are an early and peculiar stage of development of a fresh water polyzoon. They are popularly labelled "eggs" of *Cristatella*, but more accurately statoblasts or pseud-ova.—R. H W.

BOOKS RECEIVED.

Berliner Entomologischer Zeitschrift. Yahrgang 1-10. 8vo. 21 pamphs. Berlin, 1857-1866.

The Principle of the Least Action in Nature, illustrated by Animal Mechanics. By Samuel Houghton. 8vo. pp. 48. London, 1871.

La Vie au Point de Vue Physique, ou Physiogenie Philosophique. By Charles Girard. 12mo. pp. 70. Paris, 1870.

Sixth Annual Report of the U. S. Geological Survey of the Territories, embracing portions of Montana, Idaho, Wyoming and Utah; being a report of progress of the year 1872. By F. V. Hayden. 8vo. pp. 844. Washington, 1873.

Report of the Commissioner of Education for the year 1872. Cloth 8vo. pp. 1018. Washington, 1873.

Proceedings of the Lyceum of Natural History in the city of New York. Second Series. Jan. 3-March 3, 1873. 8vo. pp. 32. New York, 1873.

Proceedings of the Trustees of the Peabody Educational Fund at their Annual Meeting, New York, July 16, 1873. 8vo. pp. 61. Cambridge, 1873.

Meteorological Observations, during the year 1872, *in Utah, Idaho and Montana.* 8vo. pp. 120. Washington, 1873.

A Catalogue of the Shell Bearing Mollusca of Rhode Island. By Horace F. Carpenter. 4to. pp. 4. 1873.

Circulars of Information of the Bureau of Education. Nos. 1 and 2. 8vo. Washington, 1873.

The Mechanical Equivalent of Heat a Delusion. By A. Arnold. Sept., 1873.

The Tourmaline. By A. C. Hamlin. Cloth 8vo. pp. 107. With 5 colored plates. Boston, 1873.

The Entities and Thoughts on Development and the Origin of Species. By C. G. Forshey. 8vo. pp. 9. New Orleans, 1873.

Tidsskrift for Populære Fremstillinger af Naturvidenskaben. 8vo. Fjerde Række. Femte Binds. Fjerde Hefte. Kjobenhavn, 1873.

Twenty-first Annual Report of the Regents of the University of the State of New York on the Condition of the State Cabinet of Natural History. 8vo. pp. 190. With 13 plates. Albany, 1871.

Twenty-second Annual Report of the Regents of the University of the State of New York on the Condition of the State Cabinet of Natural History. 8vo. pp. 113. With map. Albany, 1869.

Fifty-fifth Annual Report of the Trustees of the New York State Library. 8vo. pp. 192. Albany, 1873.

Twenty-fourth Annual Report on the New York State Museum of Natural History by the Regents of the University of the State of New York. Cloth 8vo. pp 232. With 8 plates. Albany, 1872.

Annals of the Dudley Observatory. Vol. I. 8vo. pp. 319. Albany, 1866. Vol. II. Cloth 8vo. pp. 567. With 36 diagrams. Albany, 1871.

Results of a Series of Meteorological Observations, made under instructions from the Regents of the University at sundry Stations in the State of New York. Second Series. From 1850 *to* 1853, *inclusive: with records of rain-fall and other phenomena, to* 1871, *inclusive.* Prepared from the original returns by Franklin B. Hough. Cloth 4to. pp. 402. Albany, 1872.

Description of a Species of Caligulus, C. Americanus. By Charles Pickering and James D. Dana. (From Am. Jour. Sci., Vol. xxx, iv, p. 225, 1838.) 8vo. pp. 106. With 3 plates.

Popular Science Monthly. New York, Sept., Oct., 1873.

Revue Scientifique. Paris, Aug. 2 - Sept. 27, 1873.

Field. London, July 26 - Sept. 20, 1873.

Land and Water. London, July 26 - Sept. 20, 1873.

Bulletin of the Torrey Botanical Club. New York, July - Sept., 1873.

The Lens. Chicago, Aug., 1873.

Journal of the Franklin Institute. Philadelphia, Sept., Oct., 1873

The Entomologists' Monthly Magazine. London, Oct., 1873.

Grevillea. London, Oct. 2, 1873.

Journal of Botany. London, Oct., 1873.

Academy. London, Aug. 1 - Oct. 1, 1873.

Nature. London, Aug. 7 - Oct. 2, 1873.

Le Naturaliste Canadien. Quebec, Aug., Sept., 1873.

American Journal of Science and Arts. New Haven, Sept., Oct., 1873.

The Gardener's Monthly. Philadelphia, Sept., Oct., 1873.

Geological Magazine. London, June - Aug., 1873.

The Horticulturist. New York, Oct., 1873.

Annals of the Lyceum of Natural History of New York. March-June, 1873.

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OBSERVATIONS ON THE SUNDEW.

BY MRS. MARY TREAT.

On the morning of July 7th, I started in search of *Drosera filiformis* and found my plant in Atlantic Co., New Jersey. It was in full bloom and growing as thick as it could well stand, on either side of an extensive cranberry plantation. This charming plant, with its pretty pink blossoms, together with the dew-like substance exuding from the glands (the glands surmount the bristles or hairs which cover the long thread-like leaves), was one of the most beautiful sights I ever beheld. From former observations I had supposed this plant caught only small insects, but now found I was mistaken; great Asilus flies were held firm prisoners, innumerable moths and butterflies, many of them two inches across, were alike held captive until they died—the bright flowers, and brilliant, glistening dew luring them on to sure death. But what is the use of this wholesale destruction of insect life? Can the plants use them? Upon examination I find that after the death of the larger insects, they fall around the roots of the plants as if to fertilize them, but the smaller flies remain sticking to the leaves.

Careful and repeated experiments during several days revealed the fact that on some days the plants work much better than on others. Whether it was the electrical condition, or amount of moisture in the atmosphere, is yet to be ascertained.

I experimented with three species of these plants — *D. filiformis*, *D. longifolia*, and *D. rotundifolia*. I carefully removed them from all atmospheric agitation, and found they were the most active on the eleventh of July. I will therefore give the record of this day's experiments, and the state of the weather.

July 11th, thermometer stood thus — 7 A. M., 68°; 2 P. M., 79°; 9 P. M., 69°. Rain early in the morning, one-third of an inch. Wind in the morning, N. E.; 2 P. M., S. E.; 9 P. M., S. E.; with rising barometer from 29·96 to 30·05.

July 11th, 10 o'clock, A. M., I pinned some living flies half an inch from the leaves, near the apex, of *D. filiformis*. In forty minutes the leaves had bent perceptibly toward the flies. At twelve o'clock the leaves had reached the flies and their legs were entangled among the bristles and held fast. I then removed the flies three-quarters of an inch farther from the leaves. The leaves still remained bent away from the direction of the light toward the flies, but did not reach them at this distance.

Whether the action of the flies' wings may have created sufficient force to bring the leaves near enough to entangle the flies is a question I have not yet satisfactorily settled in my own mind, for dead flies did not seem to have the same power as living ones.

Fifteen minutes past ten of the same day, I placed bits of raw beef on some of the most vigorous leaves of *D. longifolia*. Ten minutes past twelve, two of the leaves had folded around the beef, hiding it from sight. Half past eleven of the same day, I placed living flies on the leaves of *D. longifolia*. At twelve o'clock and forty-eight minutes, one of the leaves had folded entirely around its victim, and the other leaves had partially folded and the flies had ceased to struggle. By half past two, four leaves had each folded around a fly. The leaf folds from the apex to the petiole, after the manner of its vernation. I tried mineral substances, bits of dry chalk, magnesia and pebbles. In twenty-four hours neither the leaves, nor the bristles had made any move like clasping these articles. I wet a piece of chalk in water, and in less than an hour the bristles were curving about it, but soon unfolded again, leaving the chalk free on the blade of the leaf.

The bristles around the edge of the leaf of *D. rotundifolia* are longer than on those of *D. longifolia*, but the leaf of the former does not fold around a fly as it does in the latter — simply the bristles curve around the object, the glands on the ends of the

bristles touching the substance, like so many mouths receiving nourishment.

Half past 10, A. M., I placed raw beef on some leaves of *D. rotundifolia;* by 1 o'clock the inner bristles were curving about it, and the longer bristles on the outer edge of the leaf were slowly curving upward. By 9 o'clock, in the evening, all the bristles of three of the most vigorous leaves were clasping the beef, almost hiding it from sight, while an equally vigorous leaf made no move like clasping a bit of dry chalk.

About 10 o'clock in the morning, I placed bits of raw apple on some of the leaves of the last named species; by 9 o'clock in the evening part of the bristles were clasping it but not so closely as the beef. By 10 o'clock next day, twenty-four hours, nearly all the bristles were curved toward it, but not many of the glands were touching it. So it would seem that these plants are really carnivorous, that they prefer, and absorb animal substances directly through their leaves. And Mr. Darwin says that by pricking a certain point in the leaf of Drosera, he can paralyze half of it, and this indicates nerves!

The following is a brief summary of the experiments.

First, with *D. filiformis.*

July 11th, 10 A. M. Pinned living flies half an inch from apex of *D. filiformis.* 10 o'clock and 40 minutes; the leaves are bent perceptibly toward the flies. 12, M., the leaves have reached the flies, and the flies' legs are entangled in the bristles and held fast by the sticky substance exuding from the glands.

Second, with *D. longifolia.*

10 o'clock and 15 minutes, A. M., I place raw beef on the leaves of *D. longifolia.* Ten minutes past 12, the leaves are folded around the beef. 11½ o'clock A. M., I place living flies on the leaves of this species. 12 o'clock and 48 minutes, P. M., one of the leaves has folded entirely around the fly. 2½ o'clock, P. M., four leaves have each folded around a fly.

Third, with *D. rotundifolia.*

10 o'clock and 35 minutes A. M., raw beef on leaves of *D. rotundifolia.* 1 o'clock, P.M., the inner bristles are curving about it, and the longer bristles on the outer edge of the leaf are slowly curving upward. 9 o'clock, P.M., all the bristles of the most vigorous leaves are clasping the beef. 10 o'clock A. M. I place bits of raw apples on the leaves. 9 o'clock P. M., part of the bristles are

clasping them. July 12th, 10 o'clock, A. M., nearly all the bristles are curving toward the bits of apple, but very few of the glands are touching them.

THE SLATES OF THE TACONIC MOUNTAINS OF THE AGE OF THE HUDSON RIVER OR CINCINNATI GROUP.*

BY PROFESSOR J. D. DANA.

In my study of the Stockbridge limestone and the associated rocks in Berkshire county, Massachusetts, I have found that the ridges are often, if not always, synclinals. They consist of the slates or schists (and sometimes quartzite) overlying the limestone; and in the downward flexures of the limestone, during the period of disturbance and metamorphism which made the mountains, the overlying beds or part of them were folded together into a compact mass which has withstood degrading agents, while the same beds in the anticlinals or upward flexures were extensively broken and have disappeared. The slate ridges are then nothing but squeezes of the slate formation between the sides of a limestone synclinal.

The Taconic mountains lie on the western border of the Berkshire limestone region; and, in general, the dip of the limestone, as well as of the Taconic slates is to the eastward, and hence the slates being underneath are seemingly the older. They are actually so, unless the Taconic ridges are also synclinals, with an eastwardly inclined axis, like some of the Berkshire mountains. Until recently I had regarded the apparent order of superposition as the true order of succession, that is, I had supposed that the limestones were newer than the Taconic slates. The conclusion seemed to be confirmed by finding at different places the slates and limestone with the same high easterly dip, the slates undermost.

But a few weeks since, on an examination of the eastern base of Mt. Washington, the highest part of the Taconic range in southwestern Massachusetts, along the road just east of the highest

* Read at the Portland Meeting of the Amer. Assoc. Adv. Science.

summit, called Mt. Everett, 2,634 feet in height above the sea, the limestone of the Sheffield plain was found to have, instead of the usual easterly dip, a *westerly* dip, and this continued up the slopes of the mountain as far as the limestone extended, about 120 feet above the plain and there the limestone was seen to pass directly beneath the slates of the mountain, these having the same dip and strike, the dip 20° to 25.° Thus the limestone was seen to descend under Mt. Washington and the slates to be the superior rock. Following along the base of the mountain northward, this dip of the Stockbridge limestone under the mountain was found to continue for nearly four miles, that is along the whole eastern front.

These facts seem to prove that the limestone of Berkshire goes under Mt. Washington and comes up in the great limestone of Copake on the west side of the Taconic range.

I might show that there are probably two close-pressed synclinals in the Mt. Washington plateau (which is four to five miles broad), with steep easterly inclined axes, and that these synclinals are synclinals of slate riding over a single broken synclinal of limestone; that, to the north of the mountain, where the mountain descends to the limestone plains of Egremont, these synclinals become separated and include an anticlinal of limestone, the limestone of the anticlinal appearing in the intermediate valley while the ridges (synclinals) are slate; and that the two synclinals have an eastwardly inclined axis, the dip being very steep to the eastward. But to explain fully would require diagrams, and I leave the details for another place.

Graylock in northwestern Massachusetts, to the east of the line of the Taconic, and 3500 feet in height, whose rocks are much like those of Mt. Washington, is described by Emmons as a synclinal; and, after a survey of the facts on the ground, observing the westerly dip of the limestones of the eastern slopes near South Adams, and the easterly dip on the western slopes near the entrance to the "Hopper," as the great central valley is called, I am satisfied that he was right. The dip at the summit and most other parts is very steep to the eastward. It appears then to be a result, like many other Berkshire Mountains, of a squeeze of the slates in a synclinal; and like Mt. Washington it is probably not a simple synclinal. It may be a double one, with the Hopper corresponding to the intermediate anticlinal, the beds of the whole

having a high dip to the eastward owing to the eastward inclination of the axis of the folds. At North Adams, in the ridge of slate just west of the village, the limestone and slate both dip eastward, there being here the north end of one of the inclined synclinals.

The making of the highest summits of the Taconic region appears thence to have depended on this doubling of the folds. It becomes exceedingly difficult in such cases to ascertain the true thickness of the slate formation.

In view, then, of the facts stated in my former article with regard to the age of the limestone and its overlying rocks, it is not easy to avoid the conclusion that *the Taconic slates are Hudson river slates*, as long since held by the Professors Rogers; and, also, that the rocks on which Prof. Emmons, in his New York Geological Report, first based his Taconic system, or out of which he devised it, are after all nothing but the Hudson river and Trenton groups, with the underlying Chazy. The Trenton limestone and Hudson River or Cincinnati groups, which properly constitute one series in American Geological History, are then *the true Taconic system*.

HINTS FOR THE PROMOTION OF ECONOMIC ENTOMOLOGY IN THE UNITED STATES.*

BY JOHN L. LECONTE, M.D.

It is indeed a most gratifying evidence of the increasing interest in the department of zoology which we cultivate, that the entomologists, now in connection with the "American Association for the Advancement of Science," are sufficiently numerous to form a separate sub-section, and enough in earnest to make the meetings of the section of value to attract our widely scattered students.

I hail with joy the opportunity of being present at this meeting, and the more so, because absence from the country has prevented me from being with you on previous occasions, when you assembled to deliberate on the means necessary for the promotion of our favorite science; to communicate to each other that which you have done of best during the year, and call on your col-

* Read at the Portland Meeting of the Amer. Assoc. Adv. Science.

leagues to rejoice with you over the gems of truth which Nature bountifully bestows on you and on all who visit with pure heart and humble mind her exhaustless treasury.

Believing, as I do, that the few days thus spent in closer communion, by those who are in sympathy in their main intellectual pursuits, should be devoted rather to mutual instruction and comparison of general views derived from our studies, than to the reading of essays on special or descriptive subjects, which sooner or later will appear in suitable places in scientific journals, I have thought it not inappropriate to give briefly some ideas suggested by a long course of investigation both in the field and in the museum, regarding the requisites for a more rapid advance of American entomology, and a more speedy development of the practical benefits which the science promises.

Before endeavoring, so to speak, to forecast the future, or to indicate those paths of research from which the most useful results may be expected, it would be well to glance at the past history of our science; so that by rapidly reviewing the steps by which progress has been made, we may be better prepared to estimate the comparative value of the agencies by which our present position has been attained.

The beginning of the American school of entomology may be considered as made in 1817 by Thomas Say, in those days the most generally instructed zoologist in the United States. Though his contributions to the literature of other departments of natural history were quite copious, yet entomology seems to have been his favorite science, and on his studies of the various orders of insects his scientific reputation must mainly rest.

At that time the text-books in entomology were mainly Fabricius, Herbst and Latreille, and the efforts of American naturalists in every branch were confined to adopting, without independent criticism, the classifications and generic determinations of their European correspondents. Biology did not exist either in name or in idea. Careful observations of a few noxious species by Prof. Peck and Dr. T. W. Harris were the slight foundation upon which the whole structure of economic entomology was to be erected.

It will be readily seen then, that the entomologists of that early period were essentially *species men*, namers and describers of the unknown objects with which they were surrounded:—a

work which was done so well that of the many hundreds of species described by Say, and the smaller number by his collaborators, scarcely any remain doubtful, and but few unknown.

Preëminent among the early naturalists of the United States, and far beyond any of them, both as an industrious collector, a careful observer in the field, and an intelligent investigator in the museum, was Dr. T. W. Harris, of Massachusetts. A man of singular modesty and diffidence, appreciated neither by himself nor by others, but whose memory will be cherished by all who knew him, and whose merits will be more and more recognized as time brings him with his limited opportunities more strongly in contrast with the other students of his day. Had he published, as he wrote, the independent investigations on classification which he made, or had the proper facilities been afforded him and the requisite stimulus given, our science in this country would have anticipated many of the schemes of arrangement developed later by the best European students.

Among the entomologists of that time, properly pertaining to our country, must be named Dr. C. Zimmermann, a German by birth, and trained to science before he made this continent his home. The monographs of *Zabrus* and *Amara*, published before leaving Europe, still remain thoroughly careful and classical studies of those genera, to which nothing has been or can be added except the descriptions of species since collected. It was a misfortune for our science that Zimmermann too, though a profound and laborious student, would never publish the results of his investigations. As a systematist in the science, he was of the very highest order, and I here cheerfully acknowledge my obligations to him for some of the hints which, afterwards more fully developed, have gained for several of my memoirs the generous approval of foreign entomologists. His manuscripts, submitted to me in 1867 by his widow, contained a large part of a systematic work on Coleoptera, with descriptions of many hundred new species of the Southern States, which, however, had been rendered of no avail by recent publications, posterior to the manuscripts in question.

After the founders of the science in this country came a period of apathy, during which nothing was done. The work of description was then resumed by Melsheimer, Ziegler and myself, without, however, any attempt at independent study of classifica-

tion or particular observation of life histories of the objects described.

The first serious monographic study made was that of the *Histeridæ*, published in 1845 by my father in the Boston Journal of Natural History, modelled on the *Monographia Histeroidum* of Paykull, and, like it, illustrated with outline figures of all the species.*

The second period in the history of American entomology now begins, in the decade from 1840–50; a most important epoch in the intellectual history of our country. An independent school of science had commenced in zoology by the investigations of James D. Dana on the polypes and crustacea collected while attached to the Exploring Expedition of Captain (now Admiral) Wilkes; in geology by James Hall of the New York Geological Survey, and by the brothers Rogers of the Pennsylvania and Virginia Surveys. Prof. Agassiz also came to us introducing methods of systematic instruction, which previously each student, after many trials, had to invent by himself, and for himself alone; and with his unequalled ability as a lecturer to excite enthusiasm in his hearers, he added a powerful stimulus to the cultivation of natural history, the effects of which can hardly be exaggerated. With few exceptions, the zoological students who have since become prominent in the United States have been instructed for a longer or shorter period by him; and it has been a frequent cause of regret to me, that my early efforts in science had not been directed by one who could so thoroughly combine kindness in instruction with firmness in criticism; who could so well temper the natural impatience for rapid publication of the young and inexperienced observer, to that calmness of judgment which permits nothing to be published until it expresses the best results which the author can at that time produce.

Another most valuable auxiliary to science in the United States, belonging to the same decade, was the establishment of the Smith-

*I have purposely excluded from this sketch of American entomology the illustrated work of Boisduval and LeConte on the Lepidoptera of North America. Although the task of collecting material and making notes on the habits of larvæ with many drawings occupied my father, Major John LeConte, for several years, the text of the work and the systematic arrangement, such as it was, were prepared abroad, not at all under his control; and the work was stopped before the completion of the first volume. All the notes and drawings which were to have been used in the study of the Heterocera were retained by his coeditor, and still remain in Europe.

sonian Institution, on a secure basis, and nearly in the form devised by its learned secretary, Prof. Joseph Henry; whereby the funds were employed chiefly in the assistance of investigators and explorers, and in the publication of scientific memoirs.

It has long been the privilege of those who labor to *extend* the boundaries of human knowledge to work hard and (in ordinary phraseology) to find themselves; and, until the organization of the Smithsonian Institution, it was their further privilege, in this country, to publish at their own individual expense all memoirs, which from bulk or cost of illustration were beyond the limited means of local scientific societies.

Under the fostering influence of this, among the most noble of the intellectual charities of the age, many valuable works on abstract science have been published; which, though produced in less than one-third of a century, by a small number of investigators, thinly dispersed over a large extent of territory, would do honor to older communities, in which students of science and their labors are not unfrequently cared for by the protecting influence of government.

It has thus come to pass that manuals and catalogues of several orders of insects have been prepared by the students best qualified to give, in a condensed form, compilations of the latest results of investigation, or entitled to put forth their own views of classification, as worthy of acceptance; and in the preparation of this series of works, valuable assistance has been rendered in orders which had not received attention from our native students, by some of the best European authorities on those subjects, among whom are specially to be remembered with gratitude Hagen, Loew, Osten-Sacken and De Saussure.

The excellence of the memoirs thus published by the Smithsonian Institution results from two facts; the persons invited to prepare the work are those who are recognized by scientific men as most competent for the labor; and the memoirs when prepared are submitted to committees capable of judging of their value. Neglect of these precautions will probably ensure greater or less failure in attempts to procure works for either primary or advanced scientific instruction; and I am the more confirmed in this opinion by the miserable result attending the munificent expenditure of the state of New York, on the volume illustrative of insects injurious to agriculture. Compiled by a person ignorant of the

science, and illustrated by a draughtsman untrained in natural history drawing, it remains a permanent example of misplaced confidence and liberality; an equal disgrace to the legislation, the science and the art, of the great state in which it was published.

The possibility of acquiring some knowledge of our insects, without the possession of large costly libraries which up to this period were indispensable, soon made the science more popular; and the names of the species beginning to be known, many persons were attracted to form collections, and others to the equally fascinating study of the life history of individual objects.

Thus arose the present condition of economic entomology; and the biological studies commenced years before by Dr. Harris were worthily continued by Dr. A. Fitch of New York, and the state entomologists afterwards appointed in several of the Western States.

Most prominent among those to whom we are indebted for the development of practical entomology was the lamented B. D. Walsh, of Rock Island, Illinois; an Englishman by birth, bringing to this country a mind well trained in classical and scientific instruction by a thorough University course, and animated by an enthusiastic love not only for science but for truth and consistency in life.

The "Practical Entomologist," a monthly magazine, published (1865 to 1867) by a committee of the entomological society of Philadelphia, was edited chiefly by him. Its successors, the "American Entomologist" and "American Entomologist and Botanist," of Saint Louis, were edited by Mr. Walsh, and Mr. C. V. Riley, the accomplished state entomologist of Missouri. These volumes will be often referred to, not only for the meritorious essays on injurious insects and for the excellent suggestions towards controlling these pests, but still more for the fearless and caustic manner in which the editors exposed many quack contrivances for exterminating our insect enemies; thus endeavoring to protect our too credulous farmers against the pretensions of ignorant inventors and shameless empirics.

Last to be mentioned, because the most recent, of the aids for the cultivation of entomology, and for popularizing the science, is the "Guide to the Study of Insects," by Dr. A. S. Packard, Jr.; a most judicious and excellent compilation from the best works on the various orders, adapted to the North American fauna, and illustrated with copious and well drawn original figures, combined

with no insignificant portion of the author's own investigations, chiefly in embryology.

Having now shown, by a hasty survey of the past, the gradual progress of our science, let us consult in regard to what is to be done to perfect the structure, the foundations of which are thus securely laid, and above all, what is necessary to popularize and utilize the great mass of information which has been obtained by so much labor.

Of all the branches of zoology, there is none more intimately connected with the great agricultural interests than entomology;* and yet from the vast number of objects involved in the study, many of which, on account of their small size, are with difficulty recognized by the untrained observer, and also from the complication of metamorphosis and habits such as are seen in no other department of the animal kingdom, there is no branch of natural history which requires for its elucidation greater industry, or higher powers of scientific analysis. For the same reasons, none of the inferior animals are so well fitted to elude and resist human control. We may therefore expect the practical application of the abstract truths and facts contained in the science to be a task of more than ordinary difficulty, requiring the assistance of the most learned students and the most ingenious investigators.

I may, perhaps, be accused of uttering a very vapid truism, when I assert that before any science is capable of rational practical application, the science must be well advanced, or at least its general principles and methods of investigation firmly established; and further that the application must be made by those who are fully informed as regards the science. Yet, by neglect of this apparent axiom, we have seen that the great state of New York expended a sum of money, almost sufficient to print all the useful books on entomology since published in the United States, upon one quarto volume, which is a monument only of presumption and ignorance.

I may be excused, then, for mentioning first those things which in my opinion will contribute to a more rapid advance in the de-

*"The entire sum expended by Congress, or by our various State Legislatures for this purpose (from 1776–1869) cannot exceed \$90,000 to 100,000, or about \$1,000 a year. Yet the annual damage done by insects within the limits of the United States cannot be less than (\$300,000,000) three hundred millions of dollars. Am. Entom. and Bot. ii. 109.

"Napoleon, at the summit of his prosperity, never inflicted more damage on a nation than the liliputian insect army inflicts on the United States." *Ibid.*, ii. 367.

scriptive and systematic portions of our science, and conclude with those relating to its future usefulness.

First, then, will come the completion of the series of works, published by the Smithsonian Institution, on the classification of the several orders. For this students must be found, who will devote themselves to the study of those orders which have been heretofore neglected. This series must be supplemented by synonymical and bibliographical catalogues, and finally by synopses of species in each order to which supplements from time to time must be made, to diminish as far as possible the necessity of reference to other works, and thus place the accurate results of science within reach of persons who can ill afford the costly libraries now necessary for reference.

Second, and equally important, will be the formation of *type* collections for the identification of species. The number of species is so vast, the differences so small, and the multitude of new forms, not yet represented in collections, so great, that the best descriptions that can be written do not obviate the necessity of referring at times to the original types for comparison, and the amount of time, labor and expense saved to students, by having the whole of the information within reach at one place for each order of insects, can scarcely be estimated.

These type collections should be in the possession of the student who can make best use of them for the present interests of science, and on his death, or retirement from intellectual pursuits, should *not be exposed for sale*, or to any other vicissitudes of fortune, but should be given to his successor in science, or placed in some public institution where they will be *most carefully preserved* and *used only for reference*.

The liberality of friends, both at home and abroad, has already made my collection of coleoptera such a type collection, and with the exception of a moderate number of species described in Europe, of which no duplicates can be obtained, and a very small number which I have described from other collections, at the solicitation of their owners, it contains types of nearly all the described coleoptera of America north of Mexico. From the saving of time both to students who visit my collection, and to myself in naming series for correspondents, I cannot too strongly recommend the formation of similar collections in other orders of insects.*

* As a proof of the earnestness of this recommendation, as well as a duty I owe to those interested in the progress of the science, who have coöperated with me in plac-

The last portion of our subject yet remains to be discussed: the practical application of the great mass of scientific truth which has been thus far gathered in relation to the structure, classification, habits and life history of insects.

Of the immense number of insects which are found in any given portion of the earth's surface, comparatively few are capable of becoming so numerous as to affect plants injuriously. But from time to time, the interference of man in the progress of civilization destroys the balance which previously existed, and insects, before unimportant by reason of their comparatively small numbers, finding the checks to their increase removed, suddenly become very destructive to one or another of our agricultural products. In this case what is to be done? Obviously there are but two courses; the first to abandon the crop, until the insect enemy is reduced by starvation to its former insignificance; the other is to establish, by human intelligence, a system of checks to take the place of the divine machinery which has been interfered with by the same human intelligence. The second is the course that is, and probably will continue to be, generally adopted.

This new system of checks, according to the habits of the insect to be suppressed, may be divided into (1) those requiring personal labor and diligence alone; (2) personal labor assisted by contrivances; (3) automatic contrivances, not requiring personal attention (including the use of poisons); (4) the production of diseases; (5) the introduction of parasites and other enemies.

Under the 1st head may be mentioned the destruction of larvæ of borers by wires, etc.; 2nd, the collecting of plum weevils, potato chrysomelæ, etc., by large nets, and their subsequent destruction; 3rd, sugaring with poisoned food, specially applicable to nocturnal lepidoptera, and the use of fires, or lanterns with a vessel of poison, to attract nocturnal species; 4th, the communication of fungoid disease (like *pebrine*, which affects the silkworm) to other lepidopterous larvæ;* 5th, introduction and preservation of insectivorous mammals, birds, reptiles and insects

ing their types in my collection. I hereby pledge myself that my collection shall never be sold or divided, but that it shall be placed permanently, where it can be best cared for, and made accessible for the authentication of specimens. And I invite those who are willing to sacrifice rarities, or even uniques in their collections for such a purpose, to send them to me, with the full confidence that they are thus rendering them of more general use than they can be in local collections.

* I am extremely hopeful of the result of using this method. I have learned of an instance in which from the communication of the disease by some silkworms, the whole of the caterpillars in a nine-acre piece of woods were destroyed.

according to the particular indication of the case; and the transportation of parasites known to affect the pest in other localities.*

In the last annual report of Mr. C. V. Riley, Missouri state entomologist, there is a very effective comparison of the ravages made by the gregarious insect pests with the destruction caused by an invading army. The same simile has been frequently used by me in conversation, and has doubtless often occurred to many of you. The application of it made by Mr. Riley is that, if an enemy were to cause a small fraction of the injury which results each year from the depredations of even one of several of our insect enemies, the whole country would resound with a clamor for the suppression of the invaders. The memory of a colossal conflict is, alas! still fresh in our minds, and I desire not to awaken the painful recollections which rest in the bosoms of us all; but leaving out reference to the distressing scenes which we have all witnessed, there was much of the ludicrous, from which we may on this occasion derive profit, or at least the material for carrying our simile somewhat farther.

Putting out of view for the moment the noble patriotism of the uncorrupted and incorruptible masses of our nation, prominent among whom were the great agricultural class, whose interests it is the object of the present inquiry to protect, we all remember vividly the eager struggle of small politicians for staff appointments, of greater politicians, innocent of martial training, for higher commands; the zeal of contractors to furnish supplies for the soldiers in the field (sometimes, as in the case of shaving soled shoes, and shoddy garments, rather aggravating than relieving their sufferings); the general hurry and scurry, and bustle and turmoil, to do everything hastily and with the greatest pecuniary profit.

Why was all this? Was the great glory to be obtained in military service, when man fights man, the stimulus? Is there not equal glory in the more laborious, albeit peaceful combats of science, when man subdues the inorganic or the organic powers which resist his will, and make them subject to his control? Or is it, perhaps, to use a common phrase of the period, because there was money in it?

* I learn from the 3rd annual report of Dr. W. LeBaron, Illinois state entomologist, that in accordance with ideas first published by Mr. B. D. Walsh, a Chalcideous parasite of a coccus, which attacks the apple tree, has probably been successfully introduced into the northern part of the state, where it was previously unknown. (*Op. cit.* p. 200).

If the latter be a part of the cause of the agitation to which we allude, let us see if the same idea cannot be utilized for our present purpose. There is money, aye, much money, in any well devised scheme for the practical application of entomology to the protection of agricultural interests. First, there is the saving of untold millions in the productions of the country, now destroyed by insect pests. Second, there is the necessity for the expansion and reorganization of the Department of Agriculture, so that it will represent and protect the farmers, to the same extent that the Coast Survey protects the commercial interests of the nation.

In this expansion and reorganization of the Department of Agriculture the controlling power should be the highest scientific ability that can be procured for the place, and the office should cease to be as it has been since its establishment, a semi-sinecure for persons of small or local political influence. New places would have to be created, but with a moderatè sprinkling of good working scientific men, many of these might be regarded like other offices, as the spoils of the dominant political party, and the interests of the farmer still be protected. Better would it be, though, if the latter class should demand that the government give them a thoroughly organized, compact, industrious body of the best trained scientific men, to teach them what should be done to control the destroyers of their labor.

There is now lying idle in Washington a great mass of notes on habits of injurious insects, collected by the untiring exertion of Mr. T. Glover, the industrious entomologist of the Department of Agriculture. This material, in its present imperfect form, if arranged under proper scientific supervision, and illustrated by figures submitted to judicious criticism, and then published in the same careful manner as the explorations of the Engineers, the Coast Survey, and other scientific departments of the government, would be of great utility in preparing the condensed reports, which should finally be accessible to every intelligent agriculturist.

One more illustration, and we will dismiss this already somewhat prolix simile of the invading army.

As in all such cases of aggression, it is competent with the higher military authorities to take private property for the benefit of the nation; so, too, a power similar in its results, though less despotic in its exercise, is necessary in our contests with the organic "powers of the air," which attack our fields. How this

authority is to be localized and manifested admits of much discussion, to enter upon which would tax your patience, and prolong this discourse far beyond the limits to which I intend to confine it. For the moment, the following may be suggested, with some modifications, as probably feasible in the extreme cases, fortunately few in number, which may be exemplified by such destructive attacks as the army or boll-worm upon cotton; the Hessian fly upon wheat; Scolytidæ (bark borers) upon pine forests; and the curculio upon plums and allied fruits.

The establishment of a fund, by the assistance of the federal government, state, or county authorities, or by private combinations, from which are to be paid owners of infected crops, which *are destroyed in order to prevent the spread of the infection.* This must of course be done under the advice of intelligent and carefully chosen agents of the authority by which the fund is to be dispensed. The rate of compensation could be easily determined at the end of the season by the average value or yield of similar crops in the vicinity, and should be such a liberal fraction of the full value, as would stimulate the owner of the property to be destroyed to declare the infection at the earliest possible moment, but at the same time not so large as to prevent due diligence on his part to confine the infection within the smallest limits.

Besides these two measures, which I consider of primary importance, there are several others, more easily under present control, by the adoption of which our accurate knowledge of the really formidable insect pests can be greatly increased, and the means for their suppression intelligently and efficiently applied. With a condensed statement of them, I shall conclude my discourse, thanking you for the kind attention with which you have favored me.

1. Reorganization of the Department of Agriculture, on a scientific basis, for the proper protection and advancement of agricultural interests.

2. Preparation of lists of the most destructive insect pests, with condensed notes of what is now known concerning them, that attention may be directed specially to those investigations necessary to complete our knowledge.

3. Coördination and coöperation of state entomologists with the chief of the Department of Agriculture, that they may work harmoniously and intelligently in concert, and thus avoid the waste

of labor now resulting from duplicate observations and repetitions in publication: collateral to this, the publication each year of a brief report containing such important advances made in the science, both at home and abroad as should be made known to the farmers.

4. Accurate calendars to be prepared of the appearance, disappearance and other phenomena of the history of the most injurious insects in different parts of the country.

5. Contrivance of apparatus on a large scale, by which, with the least expenditure of material and labor, the nocturnal species may be attracted by light, and dropped into a vessel containing cyanide of potassium or other poisonous substance.

6. Experiments on the effects of poisons upon the species, the habits of which permit the wholesale application of such means of destruction: especially adapted to nocturnal lepidoptera by the process known as sugaring for moths.

7. Careful study of epidemic diseases of insects, especially those of a fungoid nature: and experiments on the most effective means of introducing and communicating such diseases at pleasure.

8. The preparation by our best instructed entomologists working in concert, of one or more elementary books suitable for use in schools, giving in a compendious form the general principles of the science, and indications for applying the knowledge to practical results.

9. The appointment in agricultural colleges of competent professors of entomology, who have been trained in a scientific school, to fit them for the duty of instruction.

10. The establishment of the means of compensation for compulsory or voluntary destruction of crops infected by formidable pests, as above mentioned.

NOTES ON THE HONEY-MAKING ANT OF TEXAS AND NEW MEXICO.*

BY HENRY EDWARDS.

THE natural history of this very curious ant (*Myrmecocystus Mexicanus* Westwood) is so little known, that the preservation of

* Read before the California Academy of Sciences.

every fact connected with its economy becomes a matter of considerable scientific importance, and the following observations, gleaned from Capt. W. B. Fleeson of this city, who has recently had an opportunity of studying the ants in their native haunts, may, it is hoped, be not without interest.

The community appears to consist of three distinct kinds of ants, whose offices in the general order of the nest would seem to be entirely apart from each other, and who perform the labor allotted to them without the least encroachment upon the duties of their fellows. The larger number of individuals consists of yellow worker ants of two kinds, one of which, of a pale golden yellow color, about one-third of an inch in length, act as nurses and feeders of the honey-making kind, who do not quit the interior of the nest, "their sole purpose being, apparently, to elaborate a kind of honey, which they are said to discharge into prepared receptacles, and which constitutes the food of the entire population. In these honey-secreting workers the abdomen is distended into a large, globose, bladder-like form, about the size of a pea." The third variety of ant is much larger, black in color and with very formidable mandibles. For the purpose of better understanding the doings of this community, we will designate them as follows:

No. 1 — Yellow workers; nurses and feeders.

No. 2 — Yellow workers; honey makers.

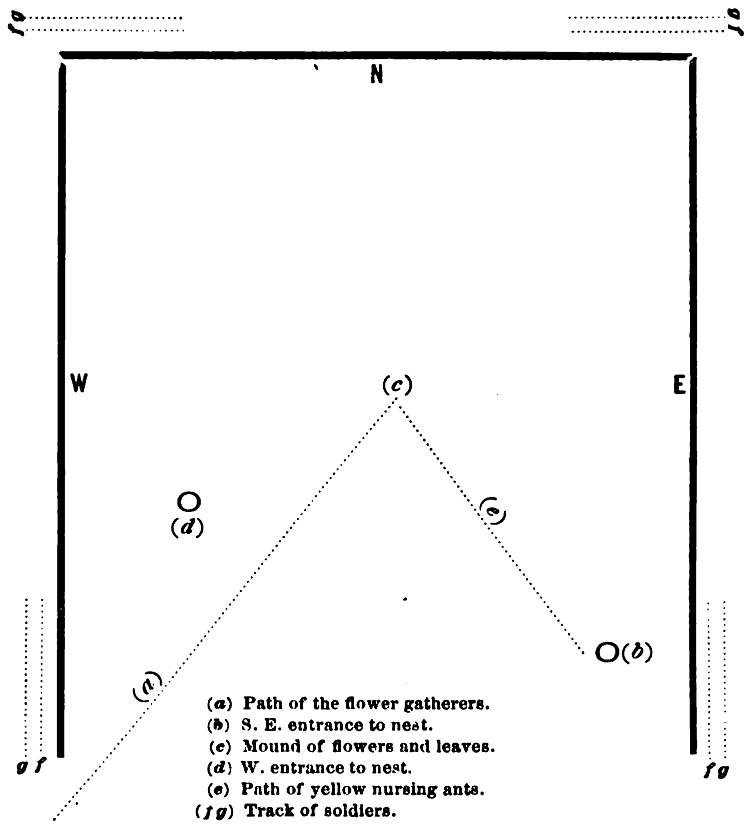
No. 3 — Black workers; guards and purveyors.

The site chosen for the nest is usually some sandy soil in the neighborhood of shrubs and flowers, and the space occupied is about from four to five feet square. Unlike the nests of most other ants, however, the surface of the soil is usually undisturbed, and, but for the presence of the insects themselves, presents a very different appearance from the ordinary communities, the ground having been subjected to no disturbance, and not pulverized and rendered loose as in the case with the majority of species.

The black workers (No. 3) surround the nest as guards or sentinels, and are always in a state of great activity. They form two lines of defence, moving different ways, their march always being along three sides of a square, one column moving from the southeast to the southwest corner of the fortification, while the other proceeds in the opposite direction. In most of the nests examined by Captain Fleeson, the direction of the nest was usually towards

the north; the east, west and northern sides being surrounded by the soldiers, while the southern portion was left open and undefended. In case of any enemy approaching the encampment, a number of the guards leave their station in the line and sally forth to face the intruder, raising themselves upon their hind tarsi, and moving their somewhat formidable mandibles to and fro as if in defiance of their foe. Spiders, wasps, beetles and other insects are, if they come too near to the hive, attacked by them in the most merciless manner, and the dead body of the vanquished is speedily removed from the neighborhood of the nest, the conquerers marching back to resume their places in the line of defence, their object in the destruction of other insects being the protection of their encampment, and not the obtaining of food. While one section of the black workers is thus engaged as sentinels, another and still more numerous division will be found busily employed in entering the quadrangle by a diagonal line bearing northeast, and carrying in their mouths flowers and fragments of aromatic leaves which they deposit in the centre of the square. A reference to the accompanying sketch will give a more clear understanding of their course: the dotted line (*a*) representing the path of this latter section, while the mound of flowers and leaves is marked (*c*). If the line (*a*) be followed in a southwest direction, it will be found to lead to the trees and shrubs upon which another division of the black workers is settled, engaged in biting off the petals and leaves to be collected and conveyed to the nest by their assistants below. On the west side of the encampment is a hole marked (*d*), leading down to the interior of the nest, which is probably chiefly intended for the introduction of air, as in case of any individuals carrying their loads into it, they immediately emerge and bear them to the common heap, as if conscious of having been guilty of an error. A smaller hole, near the southeast corner of the square, is the only other means by which the interior can be reached, and down this aperture, marked (*b*), the flowers gathered by the black workers are carried along the line (*e*), from the heap in the centre of the square, by a number of smaller yellow workers (No. 1), who, with their weaker frames and less developed mouth organs, seem adapted for the gentler offices of nurses for the colony within. It is remarkable that no black ant is ever seen upon the line (*e*), and no yellow one ever approaches the line (*a*), each keeping his own separate station and

following his given line of duty with a steadfastness which is as wonderful as it is admirable. By removing the soil to a depth of about three feet, and tracing the course of the galleries from the entrances (*b*) and (*d*), a small excavation is reached, across which is spread, in the form of a spider's web, a net-work of squares spun



by the insects, the squares being about one-quarter inch across, and the ends of the web fastened firmly to the earth of the sides of the hollow space which forms the bottom of the excavation. In each one of the squares, supported by the web, sits one of the honey-making workers (No. 2), apparently in the condition of a prisoner, as it does not appear that these creatures ever quit the

nest. Indeed, it would be difficult for them to do so, as their abdomens are so swollen by the honey they contain as to render locomotion a task of difficulty, if not to make it utterly impossible.

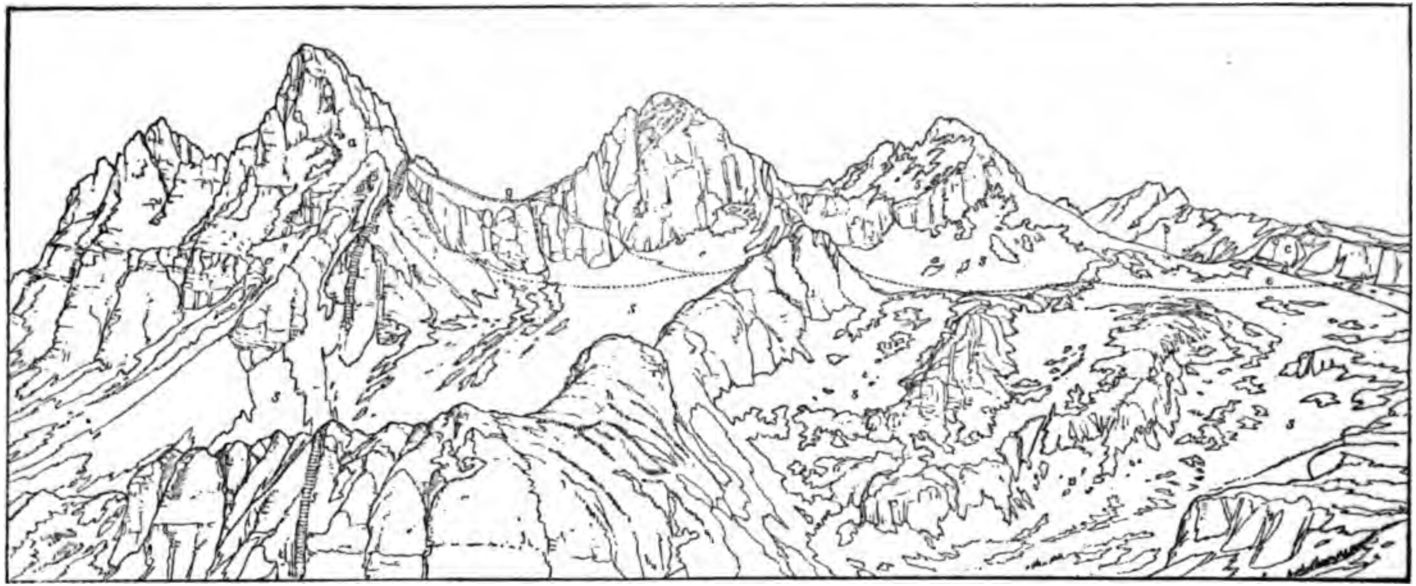
The workers (No. 1) provide them with a constant supply of flowers and pollen, which, by a process analogous to that of the bee, they convert into honey. That the remainder of the inhabitants feed on the supply thus obtained, though it is surmised, has not been established by actual observation; indeed, with reference to many of the habits of these creatures, we are in present left in total ignorance, it being a reasonable supposition that, in insects so remarkable in many of their habits, other interesting facts are yet to be brought to light respecting them. It would be of great value to learn the specific rank of the black workers (No. 3), and to know the sexes of the species forming the community, their season and manner of pairing, and whether the honey-makers are themselves used as food, or if they excrete their saccharine fluid for the benefit of the inhabitants in general, and then proceed to distil more. I regret that at this time I am only able to bring before the notice of the Academy, specimens of the honey-makers (No. 2), the other members of the community, except from Captain Fleeson's description, being quite unknown to me. It is, however, my hope that at a future meeting I may be enabled to exhibit the other varieties, and to give some more extended information upon this very interesting subject. The honey is much sought after by the Mexicans, who not only use it as a delicate article of food, but apply it to bruised and swollen limbs, ascribing to it great healing properties. The species is said to be very abundant in the neighborhood of Sante Fé, New Mexico, in which district the observations of Capt. Fleeson were made.

REVIEWS AND BOOK NOTICES.

The Scenery of the Rocky Mountains and its Origin.—Professor Hayden's last report* on the geology of the territories

*Sixth Annual Report of the United States Geological Survey of the Territories, embracing portions of Montana, Idaho, Wyoming and Utah; being a report of progress of the explorations for the year 1872. F. V. Hayden, U. S. Geologist. Washington, 1873. With plates and woodcuts. pp. 844.

Fig. 175.



Three Tétons, looking East.

a, Mount Hayden; *b*, Lake; *c*, Quebec Group Limestone; *d*, Quartzite; *e*, Granite; *ff*, Trap Dyke; *g*, "Saddle"; *h*, Timber line, 9,000 ft.; Dotted line, course of ascent; *ss*, snow.

of Idaho, Montana and Utah comes to us stored with facts bearing upon the origin of the wonderful scenery of the Rocky Mountains. The mode of formation of the lofty peaks, of the vast abyssal cañons and broad lake valleys, together with the origin of the hot springs and geysers, the last remnants of the tremendous volcanic activity that pervaded this region, is discussed with more or less detail, by Prof. Hayden, whose sixteen years' experience as a geologist in the far west certainly enables him to speak with authority on these subjects.

One of the results of these surveys was the discovery and reservation of the National Park of the Yellowstone River. How tourists may enjoy its wonders and beauties will be solved, we are told, should the railroad which contemplates connecting Corinne, Utah, with Helena, Montana, pass up Henry's Fork. That accomplished, we are promised that "all the wonders of our great national park can be seen in one day's travel on horseback from this route."

We have before spoken in this journal of the fine photographs of the Téton Range published by the Survey. This group of peaks, which are more truly alpine in character than any other known in the west, have at length been ascended by Messrs. Stevenson and Langford, the only white men who have ever reached the summit. "Immense masses of snow and lakes of ice were found on its sides, and abundant signs of glacial action." The accompanying figure (175) gives an idea of the range and the course of ascent.

Another result of the season's (1872) work was the exploration and mapping out of the great water divide from which, in a radius of ten miles, the Missouri, the Green and Colorado Rivers, and the Snake and Columbia Rivers take their rise. A new geyser basin was discovered on Shoshone Lake, and found to be the true source of the Madison River, lying on the Pacific slope, between 7,000 and 8,000 feet above the sea, with surrounding peaks 10,000 to 12,000 feet high. The basin contained from seventy-five to one hundred springs, some being geysers of considerable power, while the peculiar ornamentation about them is considered more elaborate and interesting than the celebrated springs of the Fire Hole basin, an account of which we have already given our readers. These are the more prominent results of the season's work.

Of much economic interest is the great soft coal or lignitic formation of the west. From the researches of Messrs. Lesquereux, Meek and others, together with his own, Prof. Hayden infers that

the deposition of these lignitic strata began during the latter portion of the Cretaceous period, and continued on into Tertiary times.

The origin of the Salt Lake valley, of which the remarkable Wahsatch Range forms the eastern boundary, seems due to a long continued erosion of a series of mountain chains spread over this area and resulting from a crumpling or folding of the earth's crust. "It is most probable that at a comparatively modern period the vast area between the Wahsatch Mountains on the east and the Sierra Nevada on the west was one great lake, the mountains rising up as islands in this vast inland sea. The lakes, large and small, which we find scattered over the basin at the present time, are only remnants of this former sea." Out of the flanks of these wrinkles in the earth's crust, cañons, with nearly vertical walls 1,000 to 2,000 feet high, have been carved by atmospheric agencies, such as ice, frost and water. "The valleys between these folds or ridges are synclinals, which have been deepened by erosion. The islands in Salt Lake are only the crests of these folds, while the waters occupy the synclinal valleys; and this remnant illustrates, on a small scale, the scenic beauty of the great inland sea when it extended over the entire basin."

Farther north in the Yellowstone valley are magnificent specimens of cañons whose mountain walls are formed of volcanic conglomerate 1,000 feet in thickness. Such a valley of erosion is represented by Fig. 176. In the mountains at the source of the East and Yellowstone rivers these conglomerates are sometimes 4,000 or 5,000 feet thick. These beds are supposed to have been "thrown out by volcanoes into the surrounding waters much as similar materials are injected from modern volcanoes at the present time." As these beds are horizontal and regularly stratified from base to summit, Prof. Hayden concludes "that at a comparatively modern date, the waters so covered these mountain ranges of the northwest, that not even the summits of the loftiest peaks were above the surface. It is barely possible that we might make an exception in the case of the Grand Tétons. We may suppose that the materials were supplied from the numberless volcanic fissures in unlimited quantities in a comparatively brief space of time; but the period which would be required for the waters to arrange this matter in the remarkably uniform and compact series of strata which we find at the present time must have been great.

The results have been carried on upon such a stupendous scale that the mind finds with difficulty the courage to grapple with them or attempt to explain them. And then, subsequent to the depo-

Fig. 176.

Basaltic Columns, Yellowstone, near mouth of Tower Creek.

sition of these enormous beds of conglomerates, has been the wearing out of cañons and valleys 2,000 to 4,000 feet in depth, the sculpturing of some of the most marvellously grand and unique

scenery on the continent. In passing up the valley of the upper Yellowstone, which is about three miles wide and has been carved out of this hard breccia, one could easily imagine himself in some enchanted land, where, on every side, were castles and palaces without number." Farther on our author concludes that "the erosive forces have acted on a more stupendous scale than he had ever before conceived of, and that the entire series of sedimentary strata, from the lowest Silurian to the highest Tertiary, known in the West, has extended in an unbroken mass all over the northwest; and we find here and there by the exposure of the entire series, as at Cinnabar Mountain, and in many other localities, the most satisfactory proof of the statement which I have so often made. This

Fig. 177.

Index and Pilot Peaks.

single statement implies that from 10,000 to 15,000 feet in thickness of unchanged rocks have been removed from this mountain region, except what might be called remnants left behind, occupying restricted areas."

The period of intensest volcanic activity culminated during the later Tertiary period. The mountains resulting have now assumed such forms as are shown in Fig. 177 of Index and Pilot Peaks, while Fig. 176 is an example of basaltic columns, the result of

overflows of lava, which forms the walls of the grand cañon of the Yellowstone.

The last trace of this volcanic activity, for there are now no active volcanoes in Montana or Idaho, is seen in the numerous hot

Fig. 178.

Extinct Geyser, East Fork of the Yellowstone.

springs or extinct geysers, in the valleys, of which Fig. 178 represents a good example. How this region was drained we will answer in the author's own words.

"We may conclude, not only that the carving out of the channel of the Grand Cañon was a very modern event, but that the deposition of the entire material which forms the cañon is, in a geological sense, quite a modern occurrence. The drainage of the country commenced long before the excavation of the present water-courses, but it is difficult to answer the question how this great drainage was brought about, unless we account for it by a general elevation of the entire country, gradually sending this immense body of water, which must have prevailed all over the northwest at least, perhaps all over the Rocky Mountain region, westward into the Pacific and eastward into the Atlantic. As the waters slowly subsided they were separated into lakes of greater or less size, and then came the excavation of the Grand Cañon, which slowly drained the great lake-basin above the falls so that now we have only the comparatively small remnant, the Yellowstone Lake. Other small fragments are scattered about in the vicinity, which now form reservoirs for the local drainage. Undoubtedly the same series of remarkable physical events occurred in Oregon and California and in Idaho and Washington Territories, and, perhaps, far southward into Mexico, judging from the published reports. The Hot Springs, which are now slowly dying out, are, of course, the last of this series of events. The evidence seems clear that all over the West, during this great period of volcanic activity, the hot springs and perhaps even geysers were very numerous. We everywhere find the remains or deposits in all the states and territories west of the Mississippi, and now and then a warm or hot spring remains to indicate the story of their former power."

How these valleys were eroded may be inferred from the following remarks. "On the west side of the Madison there are three or four peaks which are at least 10,000 feet high. Among these mountain-gorges we see the sources of the myriad small branches which, in the aggregate, form the large river. Nestled among the craggy cliffs are here and there little ponds of clear water, derived from the melting of the snows, seldom ever seen except by the birds and the game that visit them to quench their thirst. The tendency of all these gorges is to work their way inward toward the divide. Great masses of snow and ice accumulate in them during the winter; and the water, flowing down among the fractured masses, freezes and expands with a force that year by year tears down a portion, which falls into the depths below and is swept down

Fig. 179.

Terraces, Valley of the Madison. (Elevations are given above water level of the river.)

by the torrent. The aggregate of the forces which have continued in operation through a series of ages, which no man can determine now, and which we agree to denominate meteoric or atmospheric, are the combined action of water, air and ice. These forces have undoubtedly been far more effective in ages past than at present."

One of the latest geological occurrences in this region, as well as over the world generally, is the formation of the terraces occasionally found bordering rivers. In a basin of the Madison River is a remarkable system of terraces represented by Fig. 179. While usually in the terraces of our eastern rivers, and in fact rivers generally, those on opposite sides are of unequal height, here each terrace is uniformly of the same height as the one opposite.

In Montana neither are the anticlinal folds or synclinal valleys so distinctly defined as in the interior basin of Utah, but the prominent features are the widely extended areas of elevation.

Geologists will be interested in a feature of the geological structure of the mountains of Montana, "observed by the survey of the past season for the first time and not noticed in such a marked degree in any other portions of the west." This is the inversion of the sedimentary beds, so that the oldest incline at a greater or less angle on those of more modern ages. The mode of formation of cañons and river valleys is reserved for future discussion, but attention is drawn to the "fact that the streams seem to have cut their way directly through mountain ranges, instead of following synclinal depressions." This, he says, indicates that they began the process of erosion at the time of the commencement of the elevation of the surface. "This is shown all along the valley of the Yellowstone and more conspicuously in the valleys of the Madison and Gallatin which have carved immense cañons or gorges directly through two of the loftiest ranges of mountains in Montana."

The action of glaciers in causing this erosion Prof. Hayden thinks to have been local, and he regards the superficial or drift deposits, which sometimes are very thick, as of local origin. "As I have so often stated in my previous reports, I have never been able to find any evidence in the Rocky Mountain region of what is usually termed a northern drift."

It will be seen how much geographers and geologists as well as lovers of the marvellous and beautiful in nature are indebted to

the liberality of our government in causing these explorations to be carried out, and in placing the results directly before the people. We shall return to this report in a subsequent number of this journal, and notice the results contributed by Prof. Hayden's collaborators.

After all, the discoveries here published are the results of but a slight reconnoissance, and we trust that this is but the beginning of a long series of annual explorations, so that the outlines here sketched may be filled in with a completeness worthy of the subject.

ELEMENTS OF PHYSICAL MANIPULATION.* — This book would, perhaps, have never seen the light, or even been conceived of in the olden time of endeavoring to instruct students by talking at them from behind a formidable array of retorts, balances and batteries. By the new method the student is invited into the laboratory, and initiated into the use of the apparatus, of old so mysterious and awe-inspiring to the beginner. The tools of the physicist and chemist are now explained and their use illustrated; and, equipped with a knowledge of manipulation, the learner needs little urging to apply his information.

This text book of physical manipulation seems admirably adapted to aid the teacher in work of this kind, and for those who have not the advantages of competent laboratory instruction it seems to us that it must prove invaluable. It is also admirably designed as an introduction to the ordinary text books.

Judging by the portion relating to the use of the microscope, the style is exact and clear. The spectroscope, both solar and chemical, is described, and experiments in its use given. So for the microscope. The instrument is described, and experiments illustrating its use given, also an account of the diaphragm, oblique illumination, the study of opaque objects, the lieberkuhn, Wenham's parabolic condenser, the achromatic condenser, the polariscope, binocular, Maltwood's finder, micrometer, goniometer, camera lucida, spectrum microscope, and test objects, together with concise directions for the preparation and mounting of objects, and directions for measuring the focal length of an objective.

Prof. Pickering claims that among the experiments, several that are new, with new apparatus, such as that for ruling scales, the

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* Elements of Physical Manipulation. By Edward C. Pickering. New York. Hurd and Houghton. 1873. 8vo. pp. 225. $3.00.

photometer and the polarimeter, are for the first time described in this book. The typographical appearance of the book is most inviting, and we trust that the second volume, relating to heat, electricity and other subjects interesting to the student of physics, will soon appear.

THE SPECTROSCOPE.* — The time is perhaps coming when the scientific world will be divided into two classes, *i.e.*, those who carry a microscope, and those who carry a spectroscope in their vest pockets. For what biologist can do without his microscope, or physicist without his spectroscope? This little manual tells us what the spectroscope is, and how it has been applied in discoveries that have transcended the wildest dreams of philosophers. Mr. Lockyer tells the story with such perspicacity and interest that though we had intended to simply glance through its chapters, we have not failed to read every word of it. Admirably clear and comprehensive in style, it is beautifully illustrated and very attractive in typography. It is the first of a library of scientific manuals to be published by Messrs. Macmillan & Co., under the title of "Nature Series."

BOTANY.

SENSITIVENESS OF THE LEAVES OF DIONÆA AND DROSERA. — At the recent meeting of the British Association for the Advancement of Science Dr. Burdon Sanderson read a paper on the electrical phenomena which accompany the contractions of the leaf of *Dionæa muscipula*. The contraction of certain organs of some plants on irritation, such as the leaves of *Drosera* and *Dionæa*, especially the latter, strikingly suggest a correspondence of function between them and the motor organs or nervous system of animals. A careful series of experiments made by means of Sir W. Thomson's galvanometer, fully confirmed the hypothesis of the existence of voltaic currents in these parts; the currents being subject, in all respects in which they have as yet been investigated, to the same laws as those of muscle and nerve. At the same meeting a paper was also read by Mr. A. W. Bennett on the movements of the glands of *Drosera*. These glands, which fringe the margin of its

* The Spectroscope and its Applications. By J. Norman Lockyer. With colored plate and illustrations. Nature Series. London and New York, Macmillan & Co., 1873. 12mo pp. 117.

leaf and cover its upper side, have been shown by previous observers not to be hairs in the true sense of the term, *i.e.*, mere cellular expansions of the epidermis, but to be integral parts of the leaf, with a fibro-vascular bundle containing spiral threads (in other words a vein or nerve of the leaf) running through them, and even to be furnished with stomata. The glands excrete at all times when in a healthy condition a white viscous gluten which quickly entraps any small insect that settles upon the leaf, gradually holding it down more and more as it struggles, till escape is hopeless. The glands soon begin to move towards the imprisoned insect; but this movement is not very conspicuous at first, and is very much more decided after the insect has almost completely ceased its struggles; thus appearing not to be due to the existence of a "contractile tissue" in the leaf, which is irritated by the movements of the insect. After the lapse of some time the whole of the glands of the leaf, even those which were at a considerable distance from the insect, are found to be bending over towards it and to be almost in contact with it. After a time the insect is to all appearance digested, actually supplying the tissue of the leaf with nourishment. Very nearly the same effect was produced by substituting for the fly a piece of raw meat, the movement of the glands being somewhat slower, but ultimately almost as complete; the meat being apparently digested in the same manner. On other leaves were placed a minute piece of wood and a small piece of worsted; and in neither of these cases was the least change perceptible after a considerable time in the position of the glands or of the object itself.—A. W. B.

In this brief abstract Mr. Bennett does not mention that these movements are pretty well known of late years, since Mr. Darwin called attention to the subject. Indeed they are in this country recorded in elementary books and demonstrated to classes. Probably he is not aware that they were discovered, fully described, and their significance indicated, by Roth, a little less than a century ago. Even the folding over of the leaf, so as to enwrap the insect, to which Mrs. Treat of New Jersey called attention a year or two ago, was observed by Roth. It may now be stated that the remark, in "How Plants Behave," "if a particle of raw meat be substituted for the living fly, the bristles will close upon it in the same manner, but to a particle of chalk or wood they

remain nearly indifferent," was made upon Mr. Darwin's authority.—A. G.

VARIETY IN THE FORM OF FLOWERS IN THE SAME SPECIES.—Dr. Hermann Müller of Lippstadt has contributed to a recent number of "Nature" a remarkable paper in which he explains the existence of distinct forms and sizes of flowers, and even of distinct varieties within the same species, by their adaptation to the needs of the insects which are necessary to fertilize them, and which vary according to the position in which the plant grows. The plants especially brought forward by Dr. Müller as illustrations of this law are *Lysimachia vulgaris*, *Rhinanthus Crista-Galli* (including the variety or sub-species *R. major*) and *Euphrasia officinalis*. In each of these cases distinct varieties are well-known, and have even been distinguished by names, varying chiefly in the size and color of the petals, and the relative length of the style and stamens. These distinct varieties Dr. Müller states are generally found in very different situations, and are visited and fertilized by totally distinct insects, for which the construction of the flower is specially adapted. Those characterized by small pale colored flowers grow, as a general rule, in shady situations where they are comparatively little visited by insects, and are very commonly self-fertilized.—A. W. B.

COMPOSITION OF THE PUFF-BALL.—Prof. A. H. Church publishes in a recent number of the "London Journal of Botany," some analyses of the giant puff-ball (*Lycoperdon giganteum*), which resulted as follows:—

Composition of Lycoperdon giganteum.

	When fresh.	When dry.
Water,	90 89	—
Fat, oil, and resinous matter,	·90	11·0
Albuminoids,	5·48	66·78
Cellulose or fungin, etc.,	2·10	14·78
Ash or mineral matter,	·63	7·44
	100·00	100·00

Composition of the Ash.

Phosphorus pentoxide,	46·19
Potash.	35·48
Soda,	6 95
Lime.	2·47
Ferric Oxide,	1.08
Silica,	·66
Other substances and loss,	7·17
	100·00

The noticeable points in these analyses are the very large proportion of phosphoric acid in the ash, and of albuminoids or nitrogenous substances in the fresh plant, the latter accounting for the very highly nutritive properties reputed to be possessed by the edible fungi.—A. W. B.

NESÆA VERTICILLATA.—Our species of this genus is somewhat curious. The flowers are dimorphous—Darwin says trimorphous.

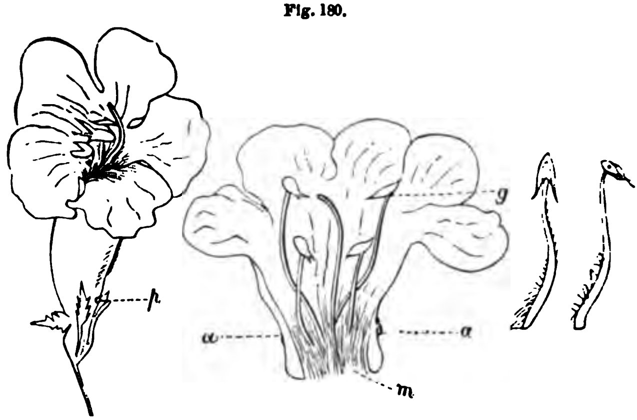
In one pond, or cluster of plants, I find the longer stamens about half the length of the style and twice the length of the shorter ones. In another the style is very short, not more than one-third the length of the shorter stamens, which, in turn, are about one-third as long as the longer ones.

But the root is, perhaps, more curious than the flowers, being very thick, sinuous and knobby, living and growing many years, hard and woody, the bark turning black when cut.—C. W.

Calycera balsamatifolia.—The curious waif of ballast ground near Philadelphia, was determined by the discoverer himself, not by Dr. Leffman, as the latter informs us, at whose request we make the correction of the statement in the Naturalist for October.

Perforation of Gerardia by Bees (see p. 689).—We unfortunately omitted to insert the cut illustrating Mr. Bailey's article on p. 689. The accompanying figure (180) shows the flower as in

Fig. 180.



Gerardia perforated by bees.

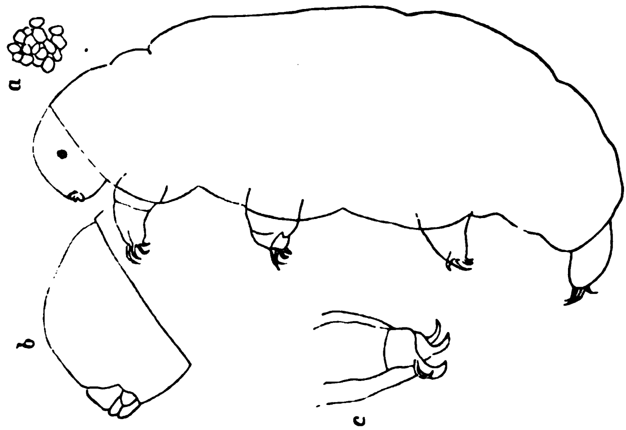
nature with the point of perforation (p); also with the corolla spread open, a, aperture; g, guiding lines; and a front and side view of a stamen.—Eds.

ZOOLOGY.

Discovery of a Tardigrade.—We are not aware that there is any published notice of the occurrence of tardigrades in this country though undoubtedly microscopists have observed them.

We received early in March of this year several specimens of Macrobiotus from Rev. W. R. Cross of New Gloucester, Maine, collected last autumn in water in which moss was growing. It is white, $\frac{14}{1000}$ inch long, and has minute eyes composed of about ten irregular facets. There is a distinct under and upper lip to the mouth, and a pair of tubercles (palpi?). It apparently differs from *Macrobiotus Oberhauseri* Doyère (Annales des Sciences Naturelles, Ser. 2., Tom. 13., 1840), to which it is closely allied in form, by

Fig. 181.



Macrobiotus Americanus.

the claws being shorter and much more curved. It may be called *Macrobiotus Americanus* (Fig. 181 *a*, eyes; *b*, mouth; *c*, claws). We have also received drawings of another species of the same genus from Prof. C. E. Bessey, of Ames, Iowa. He writes us, May 6th, that it was "found in water containing fresh-water algæ, such as diatoms, desmids, etc." It is a longer, slenderer species than *M. Americanus*, and with apparently longer and straighter claws.—A. S. Packard, Jr.

Discovery of the Basal Joint of Legs of Trilobites.—I have secured the fine collection of Trenton fossils of Mr. E. D. Walcott of Trenton Falls. It is particularly rich in Trilobites. Among the most interesting specimens, Mr. W. called my attention to one which he was confident would settle the question of the presence or absence of legs in Trilobites. And truly there can be no doubt left upon this point. The basal articulation of

eight pairs of legs is distinctly seen on one side of two specimens of *Asaphus gigas*, in the same position upon the eight thoracic rings of the two specimens, and that position is strictly homological with the base of attachment of the limbs of Isopods. There is an impression for a ninth pair of legs on the inner surface of the posterior angle of the cheek.

This discovery shows more fully than is generally admitted, that trilobites are a synthetic type. At the same time it shows that the tendency is towards the Isopods.—L. AGASSIZ.

ANCON OR OTTER SHEEP.—Professor Huxley, in an article on the "Origin of Species" (Lay Sermons, pp. 254–298), makes mention of the otter sheep which originated on the farm of Seth Wright, near Charles River, Mass.

They appear to have been noticed by David Humphreys, F.R.S., and a skeleton of one was sent to Sir Joseph Banks in 1813. Huxley says Humphreys found it difficult to obtain a specimen at that date, and further says he "believes that for many years no remnant" of the breed "has existed in the United States." In this latter statement, quite fortunately, Prof. Huxley is mistaken. Otter sheep were raised till within a few years on the farm of Hon. William Hale of Barrington, N. H. Mr. Hale has now ceased to raise them, but his son, Hon. Thomas W. Hale, tells me that he saw a flock a few weeks since on the farm of Joshua R. Chesley of Barrington, N. H. He thinks that possibly they may be found in Chichester, N. H., as some were sold from the home flock a few years since to be taken to that town. Now here is a trail that some of our naturalists should follow out. If the otter sheep were of sufficient importance to science for Humphreys sixty years ago to go to great pains to procure a skeleton to send to England, and if they afford important data on the subject of the origin of species, as with Huxley they seem to do, it is time they were reëxamined by competent authority, and skeletons secured for our own museums.

The Messrs. Hale have a fund of information respecting these sheep, for they raised them for a quarter of a century. They secured their flock as the original one of Green was obtained, by selecting from the offspring of an otter ram and common straight-legged sheep. This ram was purchased at Sligo, in Somersworth, N. H. Connection could doubtless be made thence with the Seth

Wright stock. The facts connected with the breeding of this flock are substantially the same as those given by Huxley in reference to the Seth Wright flock.

Mr. Hale, senior, thinks the progeny of an otter ram with ordinary sheep were oftener straight- than bow-legged. Mr. T. W. Hale says that he is *sure* there were never any reversions to long and straight legs when they were breeding pure otter; and a farm boy's recollection on such a matter is pretty trustworthy. The Hales think the otters were not quite as prolific as the ordinary kind. There were some things about reproduction that indicated a feebler constitution than that possessed by other varieties. I am not an anatomist and can give a description of these sheep only in general terms. They came well enough by the term "otter." We used to call them "creepers," their bodies were so close to the ground. Mrs. Hale says they were a race of cripples, and that is probably the best general designation they could have. Their legs were short and very much curved or bowed outward. The flexure of the knee joint of the fore leg instead of being longitudinal with the axis of the body was at quite a high angle from it. In other words this joint instead of being a knee became an elbow joint. So it appeared. The joints were enlarged, the gait slow and laborious. If the case of the otter sheep has any bearing on the subject of the origin of species it certainly shows that differentiation may take place by degradation as well as by elevation. If some competent anatomist will take this matter in hand the object of this article will be gained. —C. Caverno, *Amboy, Ill.*

Crows and Ravens.—In the November number of the Naturalist, Dr. Barrett, after alluding to the supposed distinct geographical range of the crow and raven, asks whether there is any antagonism between them, and whether they ever exist together. From the abundance of the crow over the eastern portions of the United States, and the almost entire absence of the raven over the same region, and its abundance further west, where the crow is commonly believed to be of rare occurrence, it has been supposed that the two species do not mingle, and that an antipathy exists between them. This impression was shared by myself until the present season, when over a region nearly five hundred miles in breadth, in the territories of Dakota and Montana, I found the

ravens and the crows both frequent and breeding in the same forests, sometimes even within a few hundred yards of each other. Both species appear to occur together over a large portion of the region between the Missouri River and the Rocky Mountains, as Dr. Hayden speaks of both as "very abundant throughout the northwest,"* applying the same words to each. Along the Heart, Yellowstone and Musselshell rivers, the crow is much the more abundant of the two, but is more confined to the timber skirting the streams, where it may sometimes be met with in considerable flocks. The raven is more generally dispersed, and is as often met with far out on the barren treeless "divides" as elsewhere, seeming to delight even in the most desolate portions of the "bad lands."—J. A. Allen.

A Note Personal.—Dr. Coues suggests, in the July Naturalist, that there ought to have been some mention of "localities" in the Aiken-Holden list. Of course there ought, and there would have been, but for causes quite beyond control without a too long postponement of the publication of the paper. Both writers were nomadic, and all communication was interrupted. It would have been well, perhaps, to have stated the occasion of this omission in justice to Mr. Aiken. It was not necessary, however, for Mr. Holden, as his localities are given, with sufficient exactness, as in the immediate vicinity of Sherman. Dr. Coues thinks that mountain settlement "quite a long way from the 'Black Hills' as laid down on the maps." He may be right. Black Hills is about as vague a term as Wh'te-head, Long Island, etc. Nevertheless, when I was near Sherman five years ago, I was assured by the residents that I was in the very heart of the Black Hills. This, however, is not pertinent to the point. We know where Sherman is, and it does not matter whether the term is exactly right or not.—T. M. Brewer.

Occurrence of a Deep Sea Floridan Coral near Cape Cod.—Perhaps the most interesting discovery during the explorations of the deeper parts of the Gulf of Maine in the U. S. coast survey steamer "Bache" in September last, under the auspices of the U. S. Fish Commission, was that of a fragment of *Deltocyathus Agassizii* Pourtales. This occurred about twenty miles east of

* Trans. Am. Phil. Soc., Vol. xii, pp. 170, 171.

Cape Cod in 144 fathoms, soft mud, the temperature of the bottom being 39.°

This is a shallow, cup-shaped, small coral, remotely allied to Caryophyllia, and has heretofore only occurred in from 60 to 130 fathoms off the southern extremity of Florida, where it was dredged by Count Pourtales, to whom I am indebted for the identification. It will be remembered that Mr. Whiteaves dredged a species of Flabellum in the deeper parts of the Gulf of St. Lawrence summer before last. — A. S. Packard, Jr.

The Missouri Skylark. — In the November number of the Naturalist Dr. Coues speaks of having met, the past season, with great numbers of the Missouri skylark (*Neocorys Spraguei*) on the prairies of the northern border of Dakota, referring to it, indeed, as one of the commonest species observed there. It seems, in fact, to be a common species over a wide area, as I had the pleasure of meeting with it myself, the past summer, from the Missouri River, near Fort Rice, to the Yellowstone, over much of which region it was quite abundant. It being a migratory species, leaving the plains of the Upper Missouri by the end of September, it seems stranger than ever before that a bird so numerous should have so long escaped observation, and that its winter quarters should still remain unknown.—J. A. Allen.

Range of the Eared Grebe. — Although this species (*Podiceps auritus* var. *Californicus*) is common along the Pacific coast of the United States in winter, it has not hitherto, to my knowledge, been found east of the Rocky Mountains in the United States, nor been known to breed anywhere within our limits. In July of this year I took several specimens in perfect plumage, at Turtle Mountain, lat. 49°, long. about 100° 30′, under circumstances which left no doubt of their breeding at this point. They were found on some of the numerous ponds about the foot of the mountain, in company with the common horned grebe (*P. cornutus*), the ruddy and various other ducks, all of which had young at the time.— Elliott Coues.

Snow Bird.—Mr. W. H. Edwards writes us that in 1842 Mr. D. W. Marsh and himself found the nest and eggs of this bird on the summit of Graylock Mountain, and that he still has two of the nests collected at that time.

Influence of Locality upon the Colors of Birds and Animals. — Not being an ornithologist, I am unable to form an opinion as to the details of the observations given by Prof. Baird, Dr. Coues, J. A. Allen, R. Ridgway and others, in reference to the colors of our American birds. But the laws of variation so far proposed are obviously provisional only. Perhaps, therefore, another suggestion in the same direction may be allowed.

While in Egypt, in the winter of 1858-9, I was struck with the predominant *dulness* of hue of the birds and animals, wild and domestic. Of the latter, the cattle and buffaloes were nearly mud-colored; so were the sheep, and, preëminently, the numerous and miserable dogs. Nothing striking appeared in the aspect of the horses (sometimes white, mostly brown), or the more commonly used donkeys. The camel is always (in Egypt at least) a dull-colored animal.

But among the birds, myriads of which were seen by us on the Nile, between Cairo and Thebes, it can hardly have been an accident that in two months, I saw not one *bright color* of any kind. White is beautifully conspicuous in the ibis, which glistens in the sun as it flies; and a grayish white is usual with the very abundant, half-domestic pigeons. But the only other hues seen were gray, brown, dull yellow and (least often) black; in land birds as well as in ducks, geese, cormorants, pelicans, etc.

It is very probable that my scrutiny may have been quite incomplete, during the two months mentioned. It is, of course, possible also, that the summer fauna of Egypt may be entirely different, especially in its birds; although (as every one knows) the temperature is rarely as low as 40° or even 50° F. in the Egyptian winter, so far north as Cairo. Yet I cannot but think that a strong contrast must exist between that region (and probably Africa farther south, also) and South America, as well as the Indian peninsulas and archipelagoes, with their brilliant humming-birds, trogons and others of the West, and pheasants, birds of paradise, etc., of the Eastern Indies. With a still more restricted observation of them, I imagined, at least, a similar comparative rarity of brilliant hues among the insects of Egypt.

Towards the possible explanation of this peculiarity (if it be admitted) one suggestion, perhaps vague, has occurred to me; the question of the novelty of which concerns me less than that of its soundness. There is certainly nothing in the climate of any

part of Africa comparable to what is referred to in Prof. Baird's account (mentioned by Mr. R. Ridgway in AMERICAN NATURALIST, Sept., 1873) of the influence of the local circumstances, causing, in birds of the interior of western North America, "a bleached or weather-beaten appearance, possibly the result of greater exposure to the elements, and less protection by dense forests." Egypt has truly no forests; only thin groves of palms, doum trees, acacias, etc. Exposure to light is a characteristic of the country. But, apart from natural selection, or, indeed, it may be possibly *through* natural selection (in part at least),—is there not a proportion between chromatic variety of development and the *complication* of natural features of the country: *i. e.*, does not the most arid, least undulating, physically most monotonous region or continent present, with slender-leafed plants and non-umbrageous trees, the *minimum* of coloration of birds, reptiles and insects,—probably also of flowers? If this idea be trite, instead of novel, my apology for bringing it forward must be my failure to discern it precisely set forth in the papers of Dr. E. Coues, J. A. Allen and R. Ridgway, who appear to be conversant with what has been written upon the subject. Although Dr. Coues, for instance, distinctly states that "the maximum of brilliancy of color is reached in the tropics," its intensity varying "in direct ratio with the *temperature* and *humidity* of the breeding place," yet the *direct* influence of heat and moisture alone would seem to be here contemplated: while the manner of that influence remains yet to be explained. At all events I shall be glad if the mention of my brief observations on the poverty of coloration in the Egyptian winter fauna call out a statement upon the subject from some competent zoologist or ornithologist, both as to the facts and their theoretic explanation.—H. HARTSHORNE.

MIMICRY IN SNAKES. — A friend recently brought me from Florida a fine specimen of the banded water-snake (*Tropidonotus fasciatus*) which had been given him by a negro as one of the dreaded moccasons (*Ancistrodon piscivorus*). The resemblance was so perfect that I did not detect the error until I examined the head. I have since examined the specimens of this species in the Smithsonian collection and find that in many individuals the coloration imitates that of the moccason to perfection. It would seem that the species are not distinguished by the Florida people.

Is not this a fair case of protective mimicry?—G. Brown Goode, *Museum, Wesleyan University.*

Notice of a Rare Bird.—LeConte's bunting (*Coturniculus LeContei*) long remained among our special desiderata. It was one of several species discovered by Audubon in 1843, on his memorable trip to the upper Missouri, the chief results of which were published in the appendix to the seventh volume of the "Birds of America." His type specimen, presented to Prof. Baird many years ago, having been lost or mislaid, as stated in Prof. Baird's work, the species rested upon the figure and description alone, until recently, when a specimen was received at the Smithsonian Institution from Texas, through Mr. G. E. Lincecum. This one was noticed in my late work (Key N. Am. Birds, p. 137). During the past summer I found the bird to be not uncommon at a certain point on the 49th parallel, between Turtle mountain and Mouse river, Dakota, where several specimens were secured. These represent the old and young of both sexes, and are particularly interesting on account of their showing that we have hitherto misapprehended the characters of the species. For Audubon's account, with which the Texas specimen agrees, indicates the extensively buffy, diffusely marked, soft plumage of the *young*, from which the adult differs materially. Some points of the case may be here presented. In form, the species differs notably from its congeners in the shape and greater relative length of the tail. This member is rather over two inches long, decidedly exceeding the wings, reaching considerably beyond the outstretched feet, and remarkably graduated, the lateral feathers being from $\frac{1}{4}$ to $\frac{1}{2}$ an inch shorter than the central pair. The tail feathers are all extremely narrow and acuminate—even more so than those of the sharp-tailed finch, *Ammodromus caudacutus.* The wings are very short and much rounded; when closed the primaries hardly exceed the longest secondary by $\frac{1}{4}$ inch, although the secondaries are not at all elongated. The bill is not so turgid as in *C. passerinus;* the younger birds have it smaller than it is in that species, as noted in the "Key;" the difference is not so great in the adults. Specimens measure from 4·90 to 5·10 in length, by 6·90 to 7·10 in extent; the wing 1·90 to 2·00, the tail 2·00 to 2·25. The general buffiness varies greatly in intensity and extent with age and wear of the plumage; it is greatest in birds of the year; an old male,

moulting, shows scarcely any. There is no yellow on the edge of the wing, nor a definite yellow loral spot, as in *C. passerinus*; there are no blackish maxillary or pectoral streaks as in *C. Henslowii*, the markings of the under parts of the adult being confined to sparse, sharp, blackish touches along the sides. In the younger birds, however, these may usually be traced across the breast, as is also the case with the young of *C. passerinus*, the adult of which is not, or not noticeably, marked below. But even the youngest specimen shows no maxillary streaks. There are some peculiarities in the shade and pattern of the variegation of the upper part; the markings of the adult being bold, sharply contrasted and heavily colored. The bill of the old bird is dark horn blue, lighter blue below; that of the young is reddish-brown, paler below. Feet flesh-colored at all ages.

I only noticed the birds on one occasion, August 9th, when a number were found together, in the deep green sea of waving grass that rolled over an extensive moist depression of the prairie. Five specimens were secured, in the course of an hour, not without difficulty; for, the grass being waist-high, the only chance was a snap shot as the birds, started at random, flitted in sight for a few seconds; while it was quite as hard to find them when killed. Several seen to fall were not recovered after diligent search. In their mode of flight, the birds resembled wrens; a simile which suggested itself to me at the time was that of a bee returning home laden with pollen; they flew straight, steadily and fast enough, but rather feebly, as if heavily freighted for their very short wings. The only note I heard was a chirring like the noise of a grasshopper. Although I found no nest, the circumstances of observation leave no doubt that the birds bred here. They were in company with a number of short-billed marsh-wrens; their neighbors of the drier prairie around were chestnut-collared buntings, Baird's buntings and Sprague's skylarks, all very numerous.— ELLIOTT COUES.

INSECT GALLS. — Mr. Riley is paying especial attention to galls and their architects. He has accumulated a vast amount of material, including all the described North American forms, with a view of soon publishing an illustrated work on the subject. He will be glad to receive assistance in the way of notes and specimens from the United States and Canada, and will take pleasure

in properly acknowledging the same. Address Mr. C. V. Riley, St. Louis, Mo.

THE OLIVE-SIDED FLYCATCHER. — The olive-sided flycatcher (*Contopus borealis*), though usually considered as a very rare bird, is quite abundant in some parts of Lewis, Herkimer and Hamilton counties in northern New York, where it breeds.

It is never found where there are no coniferous trees, and among them seems to have a decided partiality for old hemlocks. On the 12th of June, 1873, while hunting on Tug hill (Lewis Co.), I heard a bird utter a peculiar short whistle in a swamp directly ahead of me. I recognized the note as one I had heard in Idaho, but could not at once recall the species; so, guided by its oft repeated note, I entered the swamp and soon had the pleasure of seeing a fine olive-sided flycatcher perched on a dead limb on the top of a large hemlock. I shot this specimen, which proved to be an adult male in splendid plumage; I also succeeded in obtaining the female near the same spot.

At Big Moose lake, in Brown's Tract, they were quite numerous, and there we obtained several specimens (in July). They all seemed to have the same hab t of choosing a large hemlock tree with a few dead branches on top, and were sure to light on the uppermost twig. Their note, which is a short whistle, greatly resembles *O-wheo*, *O-wheo*, with the accent on the *whe*, and the voice falling at the last *o*. They sometimes repeat this note several times in succession, but generally not more than once or twice.

I was not so much surprised at finding this species breeding with us in Lewis Co., N. Y., because it is a very interesting locality for the ornithologist, and many rare northern birds are found there; but I must say I was surprised on September 10th, while hunting at Easthampton, Mass., at procuring a fine *Contopus borealis* in a small grove of pine trees within a mile of town. Since that date I have searched diligently for this bird in the same and similar localities about Easthampton, but as yet unsuccessfully. Has this species ever been obtained in Massachusetts before? — C. HARTE MERRIAM, JR.

ANOTHER MONSTER. — To the list given by me in the July number (page 435) must now be added a young cock, possessing a supernumerary wing, attached by ligaments to the ninth cervical vertebra, and hanging over upon the right side of the chest. It

was brought to me by Mr. C. B. Martin, of Tiffin, Ohio.—B. G. Wilder.

Range of the Geococcyx Californianus.—I am advised, by letter from my friend, Dr. A. Woodhull, of the army, of the occurrence of this species on the Arkansas river near Ft. Lyon, Colorado, a fact which carries the known range of the species considerably eastward. Excepting Mr. C. E. Aiken's recent quotation from the mountains of Colorado (Proc. Bost. Soc., xv, 206), the U. S. record has hitherto been only from Texas, New Mexico, Arizona and California to the Sacramento valley. The bird appears to be rare in the locality, where my correspondent says only two or three were seen in the course of over two years. He says it is known as the "war bird" or "medicine bird," because prized by the Indians for its plumage, which is used to ornament their regalia of ceremony. —Elliott Coues.

The Caribou on Lake Superior.— During a recent visit (May 1873) to Isle Royale, Michigan (Lake Superior), interesting evidence of the former presence of the Caribou (*Rangifer Caribou* Aud. and Bach.), long extinct there, was brought to my observation. I have now in my possession two relics — the greater parts of the horns of this animal — which were picked up at different points on the island. The antlers are much decayed, one being a mere shell, and, beside, they had been gnawed by rodents. Such specimens, often of a great size, are frequently discovered of late at this isolated place.—Henry Gillman, *Detroit, Michigan.*

Chimney Swallow; Change in place of Nesting.— About June 15, 1871, a pair of chimney swallows (*Chætura pelasgia*) commenced building a nest in the barn in close proximity to the nests of the common barn swallow (*Hirundo horreorum*). The nest was finished by the 4th of July, and four eggs were laid. In 1872 there were two nests built in the barn, and this year two more were built, one of which I took down on July 8th and sent, with the four eggs which it contained, to the Peabody Academy of Science. The nest that I removed was replaced by a new one about the 20th of July. As this is a remarkable variation in the habits of the chimney swift, I send you this note with the nest. I shall watch for the appearance of the birds in the barn next year with interest. As they have now built in the barn for three

years, it seems as if the birds were finding out that the chimneys were no longer suitable places for rearing their young.—J. H. SEARS, *Beverly, Mass.*

GEOLOGY.

THE FOSSILS OF COLORADO.—The explorations this year have been more than usually productive of interesting results. The "bad lands" of Colorado have been discovered to be a graveyard of a long past period, distinct from that of Wyoming, and to contain the osseous remains of a great population of beasts, of totally different species and even orders from those of the latter age and region. They resemble more nearly those of the White River, of Nebraska, but many have been obtained by Prof. Cope not known there or elsewhere. So far he has proven the existence of more than one hundred species, some represented by thousands of individuals. Of these at least seventy species are new to science. They range from the size of the mole to nearly that of the elephant; sixteen species only are reptiles.

Many forms of insectivorous animals related to the mole, and of very small size, have been procured. The delicacy and minuteness of these fossils are surprising.

Gnawing animals, or rodents, left numerous remains of eighteen species, some not larger than the domestic mouse. Some were the predecessors of the rabbits, others of squirrels and others of mice.

Of cloven-footed quadrupeds a great many species have been found. Some were nearly intermediate in structure between the deer and the hog; like the latter, they had no horns; they were about as large as sheep. Others were about the size of gray squirrels, being the smallest of this class of animals ever discovered. Several species of horses were living during the same period, as is proven by the bones and teeth which have been discovered.

Their relative, the rhinoceros, abounded in Colorado, in former days, seven species having been procured by Prof. Cope. One of the specimens is a perfect skull, with teeth complete and covered with the moss-like crystallization seen in the moss agate. But the most remarkable monsters of the past, whose existence has been disclosed by the present survey, are a series of horned species related to the rhinoceros, but possessing some features in which, according to Prof. Cope, they resembled the elephant. They

stood high on the legs and had short feet, but possessed osseous horns in pairs on different parts of the head.

One of the largest species had a huge horn over each eye, while another had one on each side of the nose, and more than a foot in length, resembling those on the back part of the head of the ox, etc. A third one, of larger size than the last, had rudimental horns on the nose. Still another was about as large as the elephant. Its cheek bones were enormously expanded, and its horns were flat. A fifth species had triangular horns, turned outward. The first mentioned species has been named, by Prof. Cope, *Miobasileus ophryas* and the others have been placed in the new genus *Symborodon*. Their structure disproves entirely the statement of a recent writer that the presence of horns in pairs is an indication of relationship to the ruminating animals (oxen, etc.), for these beasts are quite near the rhinoceros.

Carnivorous species were not rare in this ancient family, and served as now to check their too rapid increase. Of the fourteen species known, there were tiger cats, dogs, hyænadons, and the new genus *Tomarctos*. It resembled a dog, and was as large as the black bear. Some of the cats had remarkably long canine or eye teeth. In a new species, the size of the panthers, these teeth greatly resembled those of a shark.

The reptiles embrace turtles, lizards and snakes, the last two orders discovered for the first time in this formation in America.

The forthcoming reports of Professor Hayden to the Secretary of the Interior will contain a full account of the discoveries in this interesting department of geological science, made during the progress of the survey from 1870 to the present time. Prof. Cope has obtained from the ancient sea and lake deposits of Kansas, Colorado, Wyoming, Idaho, etc., about 350 species of vertebrated animals, of which he has made known to science for the first time more than 200.

Paucity of Life in Oceanic Areas.—Prof. W. B. Carpenter concludes a recent article "On the Physical Conditions of Inland Seas," with the following remarks on the paucity of life in certain areas on the ocean bottom:—

"It is well known that a muddy state of the bottom water is unfavorable to the presence of animal life; and it has been particularly noted by Dana, that where such a sediment brought

down by a current is diffused over a part of a bed of living coral, it kills the animals of that part. Moreover, I learned at Malta that in the beds which yield the extremely *fine*-grained stone which is used for delicate carvings, scarcely any fossils are found save sharks' teeth; whilst in the *coarse*-grained beds of the same formation, fossils are abundant; and as the former may be regarded as the product of a slow deposit in the *deep* sea, so may the latter be considered as *shore* beds. Further, I have been informed by Professor Duncan, that in the Fleisch of the Alps, which shows in some parts a thickness of several thousand feet, and which is composed of a very fine sedimentary material, there is an almost entire absence of organic remains.

There is, however, another condition of the bottom-water of the Mediterranean, which is *not less* unfavorable than its turbidity —probably *yet more so*—to the existence of animal life in its depths; namely, the *deficiency of oxygen* produced by the slow decomposition of the organic matter brought down by its great rivers. According to the determination which I made in my second visit to the Mediterranean in 1871, the gases boiled off from water brought up from great depths contained only about 5 per cent. of oxygen and 35 per cent. of nitrogen, the remaining 60 per cent. being carbonic acid. Now in gases boiled off from the deep water of the Atlantic, the average percentage of oxygen was about 20, while that of carbonic acid was between 30 and 40; even this large proportion of carbonic acid not appearing prejudicial to the life of the marine invertebrata, so long as oxygen was present in sufficient proportion.

The *rationale* of both these conditions seems obviously the same;—namely, that in consequence of the uniformity of temperature of the whole mass of Mediterranean water below the surface stratum of 200 fathoms (which alone will be disturbed by wind, or be affected by the influx of rivers and of the Gibraltar current), there is *no thermal circulation;* the whole contents of the deeper part of this immense basin being thus in an *absolutely stagnant* condition. If the doctrine of a vertical oceanic circulation be true, every drop of ocean water is brought in its turn to the surface, where it can get rid of its carbonic acid, and take in a fresh supply of oxygen. But as the density of the surface stratum of the Mediterranean is never rendered greater by reduction of temperature, than that of the mass of water it overlies, there is no agency capable of producing any interchange; the bottom water charged with the slowly gravitating sediment is never disturbed; and the organic matter contained in that sediment consumes its oxygen so much more rapidly than it can be supplied from above by diffusion through the vast column of superincumbent water, that nearly the whole of it is converted into carbonic acid, scarcely any being left for the support of animal life.

These considerations, then, seem fully adequate to account for the paucity of life in the deeper part of the Mediterranean basin: and they will, of course, equally apply to the case of any other inland sea, so far as the same conditions apply. And it is not a little interesting to find that my old friend and fellow-student Edward Forbes was perfectly correct as to the limitation of animal life—so far as regards the Ægean Sea, in which his own researches were prosecuted—to a depth of about 300 fathoms; the error, which was rather that of others than his own, being in the supposition that this limitation applies equally to the great ocean basins, past as well as present. The researches in which it has been my privilege to bear a part have shown that *as regards the latter* there is probably no bathymetrical limit to animal life; while the results of my inquiries into the influence of the physical conditions of the Mediterranean, in limiting the bathymetrical diffusion of its fauna, will not, I venture to hope, be without their use in geological theory."

THE CONNECTICUT VALLEY IN THE HELDERBERG ERA.—Prof. Dana states in an article in the "American Journal of Science and Arts" for November, that the observations of Hitchcock and Percival, with his own, lead towards the view that in the Helderberg era the Connecticut valley, through its whole length from north to south, was a wide crinoidal and coral growing sea, separating eastern from western New England.

ANTHROPOLOGY.

INDIAN ROPE AND CLOTH.—The *Apocynum cannabinum*, Indian hemp, or silk plant, as it is sometimes called, is very extensively used by the Indians of Arizona for the manufacture of twine and cloth. The bark of the plant is tough and strong and something like flax. The Indians cut the plant when ripe and rub it so as to separate the fibres, with which they make very strong and beautiful fishing lines, and a fine thread which they use in sewing and also make into cloth. In the Department of Agriculture, there is a fine specimen of rope made of this fibre by the Ute Indians, which I obtained from them and presented to the Department. In the Smithsonian Collection there are also good specimens of strings and a fishing net made of this plant by the Indians of Arizona. Near Camp Lincoln in Arizona we obtained, from some old Aztec ruins, cloth that had been manufactured by hand from this plant.

The root gives out a very bitter milky fluid that is used as a medicine by the Indians.—DR. EDWARD PALMER.

An Error Corrected.— During the past summer and autumn many western and perhaps some eastern papers contained accounts of the discovery of a human skull in the carboniferous limestone of southern Kansas, by one of the instructors at the Catholic Osage Mission in that state. Its determination as a cranium reposed on the authority of a physician of the town. Deeming the statement to be incredible, some later newspaper article asserted the specimen to be the skull of a deer. As this determination is not more reasonable than the first, I requested some photographs, which were obligingly sent by mail. These representing an object very much like a human cranium, I determined to visit the Mission. On reaching it I was kindly shown the specimen by Father Schumacher, the principal. It proved to be the broad body-whorl of a large cephalopod shell, allied to *Goniatites*. Some specimens exhibited with it as petrified portions of a hay-stack which had been long exposed, were fragments of some kind of slag.—E. D. Cope.

MICROSCOPY.

Exudations of Diphtheria and Croup. — Dr. Jabez Hogg, President of the (London) Medical Microscopical Society, in a recent communication to that society, combats the somewhat prevalent doctrine that diphtheria and croup are essentially the same disease. From the bold assertion that nothing but a "clinical tradition" separates these two diseases, and from the contradictory evidence of clinical medicine, he turns to histological anatomy for a solution of the difficulty, and maintains that a sharp line can be drawn between the diphtheritic membrane and the croupous cast. The former he finds a dense, compact, opaque, felt-like membrane, firmly adherent and not removable spontaneously, which when forcibly detached comes away in fragments and leaves a broken and bleeding surface. This membrane, under a microscopical power of $\times$ 350, is seen to consist of fibrous and connective tissue, shrunken and compressed cells (epithelial, muscular, glandular, and even cartilaginous), fat molecules, muco-purulent or glandular corpuscles, crystals, starch granules, fungus spores, and other foreign bodies. On the other hand the croupous cast is a delicate, semi-transparent, often gelatinous exudation, not so intimately connected with the subjacent mucous membrane but that it is easily separable as an imperfect cast which is often thrown off during a fit of coughing. Under the same magnifying

power it is found to consist of pavement and ciliated columnar epithelium and a homogeneous, transparent, albuminous substance, (never truly fibrous) entangling detached epithelial cells or their contents, fat, mucous corpuscles, and a few foreign bodies. These casts rarely contain fungus spores; continue probably to be thrown off soon after their formation; and appear to partake rather of the nature of an excessive cell proliferation than of a true exudation: they are essentially an epithelial layer cast off and resembling the skin shed by some of the lower animals.

On the other hand, Dr. Bruce and Mr. Golding Bird stated that they had never noticed epithelium in the croup membrane, but that they had observed an infiltration of exudation cells (white blood corpuscles).

"UNUSABLE" OBJECTIVES.—Mr. Henry U. Janson writes to the "Monthly Mic. Journal" proposing the wet front, or "aquatic nozzle" as a cure for "unusable sixteenths" and other objectives whose angular aperture has been increased at the expense of working focus until they can no longer come within reach of a large proportion of mounted objects. Being accustomed to work upon diatoms with a moderate angled $\frac{1}{16}$, he was induced to procure an improved lens of the same power, but 175° angle. This "tremendous 175°" performed beautifully upon all that it could reach, but about half his extensive collection of diatoms was out of its reach by reason of thickness of cover-glass; and all his high power objects have long been labelled "$\frac{1}{16}$" and "O. $\frac{1}{16}$" to indicate whether the new or the old sixteenth should be used upon them. Finally, having his new $\frac{1}{16}$ changed into an immersion he found that not only was the brilliancy of its performance increased and its power raised to about $\frac{1}{20}$, but that its focus was so much elongated that all his O. $\frac{1}{16}$ objects became perfectly usable. The comparatively long working focus of immersion lenses is a convenience well known and appreciated, but it has not, perhaps, been hitherto so formally recommended as a cure for the (also well known) "unusable" dry lenses of large angle.

MOUNTING IN BALSAM.—Mr. C. L. Jackson mounts his balsam objects in a chloroformic solution of balsam, and, after the air bubbles have all escaped, bakes them for about two days upon the flat top of a copper or tin box about a foot square and two and a half inches deep, and filled with water which is kept by means of

a gas flame at nearly a boiling temperature. For keeping the cover in position while the balsam is hardening, he finds the spring clip troublesome and uncertain, and substitutes shot or bullets, of different sizes according to the pressure required, laid upon the cover glass. The bullets are previously flattened by a blow from a hammer. [The conical rifle-balls which the writer has used for the same purpose are exceedingly convenient.]

PRESERVING TUMORS, ETC., DURING TRANSPORTATION.— Dr. J. G. Richardson recommends the popular mounting medium, a saturated solution of acetate of potash, as a temporary preservative of urinary deposits or other pathological specimens that are to be transmitted by post. Sections of tumors or of other tissues may often be prepared by soaking in this solution for two days. They are then to be removed from the solution, without much squeezing, and placed in a piece of india-rubber tubing, or wrapped up in sheet rubber or oiled silk, with the ends firmly tied, and mailed in an ordinary letter, the deliquescent fluid with which the tissue is saturated preventing alike the decomposition or desiccation of the object.

AMPHIPLEURA PELLUCIDA AS A TEST OBJECT. — Mr. Louis H. Noe, of Elizabethtown, N. J., has resolved this object, both dry and in balsam, with sunlight, through the ammonio-sulphate cell condensed obliquely with a small $2\frac{1}{2}$ inch lens, with all of the following objectives: — R. & J. Beck's $\frac{1}{40}$ dry, $\frac{1}{10}$ wet; Powell & Lealand's $\frac{1}{25}$, $\frac{1}{16}$, $\frac{1}{8}$ dry, $\frac{1}{16}$, $\frac{1}{8}$ wet; Wales' $\frac{1}{15}$ wet; Gundlach's $\frac{1}{24}$ (No. viii) wet; Hartnack's $\frac{1}{16}$ (No. x), $\frac{1}{12}$ (No. ix) wet; Tolles' $\frac{1}{10}$ dry, $\frac{1}{10}$, $\frac{1}{6}$ (130°) wet; and Spencer's $\frac{1}{4}$ wet.

NOTES.

THE Yellowstone Expedition, Gen. D. A. Stanley commanding, arrived at Fort A. Lincoln, D. T., September 22d, having passed a little over three months in active operations in the field, and accomplished a march of nearly one thousand miles through a region previously but very imperfectly known. The expedition left Fort Rice, D. T., June 20th, and arrived at the Yellowstone, a few miles above Glendive's Creek, July 15th. Crossing the Yellowstone at this point, the expedition proceeded up the valley of the Yellowstone as far as Pompey's Pillar, two hundred miles

above Glendive's Creek and about three hundred and fifty miles above the mouth of the Yellowstone. From Pompey's Pillar the expedition marched westward to the Musselshell, striking this river near the 109th meridian. Descending the Musselshell to the Big Bend, the course was thence eastward to the Yellowstone, which was reached at a point about seventy-five miles below Pompey's Pillar. The route thence homeward was essentially the one pursued on the outward journey.

The general object of the Expedition was successfully accomplished, and much general information respecting the country was obtained; considerable collections were also made in nearly all departments of natural history. The scientific corps attached to the expedition consisted of J. A. Allen, of the Cambridge Museum, in charge of recent and fossil zoölogy and botany, Dr. Nettre, mineralogist, E. Konopicky, artist, W. R. Pywell, photographer, and C. W. Bennett, taxidermist. The country visited afforded only the usual limited variety of animal and plant life characteristic of the drier portions of the plains, and the geological features presented an almost equal uniformity. The region traversed is embraced almost wholly within the great so-called "lignite tertiary basin," but contains also here and there little insular areas of upper cretaceous strata. The whole series of beds are hence below those so rich in fossil vertebral remains that occur so abundantly a few hundred miles further south; hence the fossils obtained were almost wholly molluscan, with a few imperfectly preserved remains of plants. The rapidity and great length of the marches the expedition was compelled to make, together with the proximity of hostile Indians, prevented so thorough an exploration of the country as was desirable, yet a large amount of information was gathered in respect to the topography of the region traversed, and its natural productions and resources, which is to be embodied in reports to the Secretary of War.

We have already recorded the gift to Prof. Agassiz of $100,000 from his son-in-law, Mr. Shaw. This sum is to be expended in enlarging the collections of the Museum of Comparative Zoology, as it is to be hoped that the state of Massachusetts will pay for the enlargement of the buildings. With this sum have already been purchased the Watchsmuth collection of western crinoids, including 400 species of the Carboniferous age in a beautiful state

of preservation, 170 being types of figures published in western geological reports; a large collection of trilobites from Trenton Falls, N. Y.; 2,500 skeletons from Prof. Ward of Rochester; Dr. Klumzinger's collection of fishes from the Red Sea; the Moesch collection of Jurassic fossils; a large collection of Pacific coast insects; the types of Loew's American Diptera, an exceedingly valuable collection; and Gulick's collection of Sandwich Island shells. Meanwhile the new rooms in the museum are nearly ready for the exhibition of specimens.

THE forty-third meeting of the British Association for the Advancement of Science was held at Bradford. Dr. Joule had been elected President for this meeting, but owing to ill health he was unable to be present, and Prof. A. W. Williamson presided and delivered an admirable inaugural address. With either this or Prof. Allman's philosophical and profound address before the Biological Section, we wish we could say the address of the President of the American Association compared favorably. Neither in the method of treatment nor in its spirit or style did the American production do credit to the occasion. In another number we shall make liberal extracts from Prof. Allman's address. The Association meets next year at Belfast, Ireland, Dr. Tyndall presiding.

A MEETING of the National Academy of Sciences was held October 28th and 29th, 1873, in New York City. The following papers relating to biology were read: — "Results of explorations of the deeper portions of the Gulf of Maine with the dredge," by A. S. Packard, Jr; "On the distribution and primitive number of spiracles of insects," by A. S. Packard, Jr.; "Cycles of deposition in American sedimentary strata," by J. S. Newberry; "On a new method of analysis of composite sounds, and on experiments elucidating Helmholtz's hypothesis of audition," by A. M. Mayer; "On the relations of the different classes of vertebrates," by Theodore Gill; "Biographical memoir of the late Prof. J. F. Frazer," by J. L. LeConte.

WE are requested, by Dr. Coues and Mr. Ridgway conjointly, to state that neither of these gentlemen "desires to continue a controversy of no scientific consequence, and one which, furthermore, has lost its personal interest since a mutual misunderstanding in

which it arose has been explained to their entire satisfaction." Mr. Ridgway further desires us to state that "he is willing to retract the implication of bad faith on the part of Dr. Coues."

THE meeting of the French Association for the Advancement of Science was held at Lyons from the twenty-first to the twenty-eighth of August, under the presidency of Prof. Quatrefages. The sections were fifteen in number, comprising among others Agriculture and Medicine. There were excursions down the Rhone, and to Geneva, with other entertainments.

THE new building of the Indiana State University at Bloomington, which is to be used principally for a museum, will be completed next month, and the Owen collection of between eighty and ninety thousand specimens, purchased by the trustees of the university three years ago, will be arranged at once. This collection contains, it is said, a nearly perfect skeleton of the Megatherium and many other rare and valuable specimens. The trustees have also just purchased a full series of casts from Prof. H. A. Ward of Rochester, at an expense of about $7,000, which will also be at once arranged in the new museum.

WE learn from "Nature" that Prof. Planchon has been charged by the French government with the duty of visiting America to study the ravages of the new vine disease occasioned by the plant louse, *Phylloxera vitifoliæ.*

M. COSTE, known by his elaborate work on embryology, and more recent experiments in fish raising, lately died in Paris, aged sixty-six.

PROF. CZERMAK, the physiologist, died in Leipzig Sept. 16th.

ALBANY HANCOCK, the distinguished English anatomist, died Oct. 24th.

AMONG Macmillan's recent announcement of new books, are the following: Cave Hunting; Researches on the Evidence of Caves respecting the Early Inhabitants of Europe, by W. Boyd Dawkins; The Physiology of the Circulation in Plants, in the lower Animals and in Man, by J. Bell Pettigrew; The Origin and Metamorphoses of Insects, by Sir John Lubbock, and the Elements of Embryology, by Michael Foster. Mr. R. Hardwicke announces Man and Apes, by St. George Mivart.

BOOKS RECEIVED.

Acrididæ of North America. By Cyrus Thomas. (From Report of the U. S. Geological Survey of the Territories.) 4to. pp. 262. With plate. Washington. 1873.

Synopsis of New Vertebrata from the Tertiary of Colorado obtained during the summer of 1873. By E. D. Cope. (From the seventh Annual Report of the U. S. Geological Survey of the Territories.) 8vo. pp. 19. Washington, Oct., 1873.

Report of the Director of the Central Park Menagerie, Department of Public Parks, City of New York, for the year ending May 31, 1873. 8vo. pp. 33. New York, 1873.

Annales de la Societe Entomologique de France. Serie 5; Tome ii. 8vo. pp. 694. 16 pls. Serie 4; tome x, cahier 2. 8vo. pp. 128. 6 pls.; cahier 3. 8vo. pp. 144. 8pls. Paris, 1872.

Bulletin de la Societe Imperiale des Naturalistes de Moscou. Annee 1872. No. 4. 8vo. 3 pls. Moscou, 1873.

Jahrbuch der Kaiserlich-koniglichen geologischen Reichsanstalt. Band xxiii. No. 1. Plates 1-4. 8vo. Wien, 1873.

Verhandlungen der k. k. geologischen Reichsanstalt. 8vo. Nos. 1-6. Wien, 1873.

Nuovo Giornale Botanico Italiano. 8vo. Vol. i. 13 plates. 1869. Vol. ii. 8 plates. 1870. Vol. iii. Nos. 1-3. 7 plates. 1871. Firenze.

Bulletin Mensuel de la Societe d' Acclimatation. 8vo. Series 2. Nos. 1-4. Paris, 1873.

Memoires de la Societe Royale des Sciences de Liege. 8vo. Serie 2. Tome iii. 6 pls. Liege, 1873.

Diptera Americæ septentrionalis indigena. By H. Loew. 8vo. pp. 300. Berolini, 1865-1872.

Biologie der Kalkschwamme (Calcispongien oder Grantien). By Ernst Haeckel. 8vo. Berlin, 1872.

Zeitschrift fur Akklimatisation. 8vo. Jahrgang ix. Nos. 7-12. 1871. Jahrgang x. Nos. 1-12. Berlin, 1872.

Oversigt over det Kongelige Danske Videnskabernes Selskabs Forhandlinger. 8vo. No. 2. Kjobenhavn, 1872.

Om Lovene for Vandets Bevægelse i Jorden. Af A. Colding. 4to. 2 plates. (From Vidensk. Selsk. Skr., 5 Række, Naturvidenskabelig og Mathematisk Afd., ix. Bd. 8). Kjobenhavn.

Krystallografisk-optiske Undersogelser, med særligt Hensyn til isomorfe Stoffer. Af Haldor Topsoe og C. Christiansen. 4to. (From Vidensk. Selsk. Skr., 5 Række, Naturvidenskabelig og Mathematisk Afd., ix Bd. 9.) Kjobenhavn.

Forgreningsforhold hos Fanerogamerne, betragtede med særligt Hensyn til Kloevning af Nækspunktet. Af Eug. Warming. 4to. 11 plates. (From Vidensk. Selsk. Skr., 5 Række, Naturvidenskabelig og Mathematisk Afd. 10 de Bind. 1. Kjobenhavn.

Thermochemiske Undersogelser. Ved Julius Thomsen. 4to. (From Vidensk. Selsk. Skr., 5 Række, Naturvidenskabelig og Mathematisk Afd., x Bd. 2. Kjobenhavn.

Memoires de l'Academie Royale des Sciences, des Lettres et des Beaux-arts de Belgique. Tome xxxix. 4to. Bruxelles, 1872.

Bulletins de l'Academie Royale des Sciences des Lettres et des Beaux-arts de Belgique. 8vo. 40me Annee, 2me Ser., T. xxxii, 1871; 41me Annee, 2me Ser., T. xxxiii, 1872; 41me Annee, 2me Ser., T. xxxiv. Bruxelles, 1872.

Memoires Couronnes et autre memoires, publies par l'Academie Royale des Sciences, des Lettres et des Beaux-arts de Belgique. 8vo. pp. 156. Bruxelles, 1872.

Annales Meteorologiques de l' Observatoire Royale de Bruxelles. Annee 5. 4to. Bruxelles, 1871.

Observationes des Phenomenes Periodique des l' Academie Royale de Belgique pendant l'annee 1870. 4to. pp. 59. (Extrait du tome xxxix des Memoires.)

Tables de la Mortalite et leur Developpement. Par Ad. Quetelet. 4to pp. 39. Bruxelles, 1872.

Annuaire de l' Academie Royale des Sciences, des Lettres et des Beaux-arts de Belgique. 12mo. 38me Annee, 1872; 39me Annee, 1873. Bruxelles.

Descriptive Ethnology of Bengal. By Edward Tuite Dalton. 4to. pp. 327. Illustrated by lithograph portraits copied from photographs. Calcutta, 1872.

Centieme Anniversaire de Fondation de l' Academie Royale des Sciences, des Lettres et des Beaux-arts de Belgique. Tomes premier et second. 8vo. Bruxelles, 1872.

Memoirs on the Spermogones and Pycnides of Lichens. 4to. pp. 49.

Monthly Report of the Department of Agriculture. Washington, Oct., 1873.

Report on the Fossil Plants of the Lower Carboniferous and Millstone Grit Formations of Canada. By J. W. Dawson. (From Geological Survey of Canada.) 8vo. pp. 47. 10 plates. Montreal, 1873.

Eighth Report of the Quekett Microscopical Club, and List of Members. 8vo. pp. 48. London, July, 1873.

Astronomical and Meteorological Observations made during the year 1870, *at the U. S. Naval Observatory.* 4to. pp. 723. Washington, 1873.

Popular Science Monthly. New York, Nov., 1873.

Revue Scientifique. Paris, Oct. 4-25, 1873.

Le Naturaliste Canadien. Quebec, Oct., 1873.

Nature. London, Oct. 9-30, 1873.

Canadian Naturalist. Montreal. Vol. vii. Nos. 2 and 3.

Journal of the Quekett Microscopical Club. London, Oct., 1873.

Entomologists' Monthly Magazine. London, Oct., 1873.

Canadian Entomologist. London. Vol. iv. Nos. 8 and 9, 1873.

Quarterly Journal of Microscopical Science. London, Oct., 1873.

The Field. London, Sept. 27 - Oct. 25, 1873.

Land and Water. London, Sept. 27 - Oct. 25, 1873.

Academy. London, Oct. 15, 1873.

Bulletin of the Torrey Botanical Club. New York, Oct., 1873.

American Journal of Science and Arts. New Haven, Nov., 1873.

Bulletin of the Buffalo Society Nat. Sciences. Buffalo. Vol. 1. No. 3.

Journal of the Franklin Institute. Philadelphia, Nov., 1873.

Grevillea. London, Nov., 1873.

INDEX TO VOLUME SEVEN.

APPENDIX

TO

THE AMERICAN NATURALIST,

JULY, 1873.

ON PROFESSOR MARSH'S CRITICISMS.

THE recklessness of assertion, the erroneousness of statement, and the incapacity of comprehending our relative positions, on the part of Professor Marsh, render further discussion of the trivial matters upon which we disagree unnecessary; and my time is too fully occupied on more important subjects to permit me to waste it upon personal affairs which are already sufficiently before the public. Professor M. has recorded his views "*ære perenne*," and may continue to do so without personal notice by E. D. COPE.

APPENDIX

TO

THE AMERICAN NATURALIST,

JUNE, 1873.

REPLY TO PROFESSOR COPE'S EXPLANATION.

BY O. C. MARSH.

THE May NATURALIST (p. 290) contains Professor Cope's long promised "explanation" of the many errors and false dates in his recent publications, and a most remarkable document this explanation is. As a sleight-of-hand performance with names and dates, it shows practice, and is amusing; but to those familiar with the subject, and to moralists, it suggests sad reflections.

What was fairly demanded of Prof. Cope under the circumstances was:

1st. An acknowledgment, or a full correction, of his numerous mistakes in regard to the *Dinocerata*.

2d. Some definite proof of the publication of his late papers at the dates claimed.

3d. An explanation of the antedating of seven of these papers in the "Proceedings of the American Philosophical Society."

4th. A prompt retraction, and satisfactory explanation, of his false report in "Nature" of this Society's meetings.

Instead of this, Prof. Cope has merely given a tangled web of misstatements and misrepresentations which can mislead no one who will carefully compare them with the facts, or even with this author's previous statements. In his whole explanation there is not a straight-forward answer to a single point I have made against his work; the important facts in each case being either suppressed, or so twisted as to mitigate the force of my criticism. In the numerous cases where no answer appeared possible, he has quietly dismissed the charges as "frivolous" or "insignificant." To expose this plausible system of defence is an easy task, requiring

plain language, perhaps, but neither loss of temper, nor a dictionary of Latin quotations.

I.

First, as to Prof. Cope's *Dinocerata* blunders. I have pointed out some forty of these in four separate papers. In his explanation, however, Prof. Cope replies to only one of these papers, thus at the outset coolly ignoring three-fourths of his own errors. The paper chosen for reply, moreover, is one that probably few readers of the NATURALIST have seen, and its selection, rather than those in this journal (pp. 146 and 217), well illustrates the characteristic feature in this defence.

Quoting from my article in the "American Journal of Science" (v, p. 117) Prof. Cope refers, 1st, to my correction of his blunder in mistaking canines for incisors, and asserts that he "had determined and stated them to be canines before the appearance of this criticism." Prof. Cope here deliberately suppresses the most important facts, viz :—that I first corrected this blunder at the meeting of the American Philosophical Society, December 20th, 1872, in his presence,* and again subsequently in this journal, vol. vii, p. 52, a month earlier than the paper he cites.

2d. To my criticism, that "The stout horns he described are not on the frontals, but on the maxillaries," Prof. Cope replies with his characteristic tactics. My statement was based on his description of *Tinoceras grandis* Marsh (= *Eobasileus cornutus* Cope = *Lefalophodon dicornutus* Cope = *Loxolophodon cornutus* Cope) and a reference to the figures of this species accompanying Prof. Cope's article proves my assertion beyond question.

3d. The correctness of my statement as to the position of the orbit in the *Dinocerata* is likewise fully proven by the above figures, and those of *Dinoceras*.

4th. The oblique position of the occiput also is fully established by the same illustrations. Prof. Cope has again suppressed an important fact, viz. :— my statement that, in the *Dinocerata*, the head when in its natural position was declined.† I first pointed the character out, and yet Prof. Cope now insinuates that I did not know it!

5th. The temporal fossa is not small posteriorly, but unusually large, and neither this character, nor Prof. Cope's blunder in stating otherwise, was frivolous.

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* Proceedings, Vol. xii, p. 579. † American Journal of Science, v, p. 296.

6th. Prof. Cope states that the great trochanter of the femur "is flat, as in the Elephants." It is not flat in the *Dinocerata*, nor in the Elephants.

7th. The spine of the tibia is wanting, as I have stated, and this "frivolous" point Prof. Cope has since regarded as an ordinal character.

8th. Prof. Cope admits that he mistook the posterior horn-cores for nasal bones, and naturally is vexed to have his blunder pointed out.

9th. That the extremities of the nasals are not excavated, the photographs of Prof. Cope's type specimen clearly show. These photographs prove also that the malar bone is of the true Perissodactyl type. They fail to show the proboscis on which Prof. Cope relies for his most important ordinal character!

Prof. Cope's statement (p. 298) that I based a generic distinction on a small tubercle on one of the molars of *Uintatherium* is only another instance of his deliberate inaccuracy, and is at once disproved by my descriptions (Am. Jour. Sci., v, p. 408).

Prof. Cope's figures are too indistinct, and differ too much from the specimens, for any great dependence to be placed upon them. On comparing them with the photographs from which they were taken, however, the denial of Prof. Cope (p. 315) that he had reversed the tusks is at once shown to be untrue. The inner face of the canine, with its enamel worn away by attrition, is plainly to be seen on the outside as now placed, and to deny this is an insult to every anatomist who has seen the specimen or photographs. In several other points these plates are incorrect, and to get on his problematic posterior horn-cores Prof. Cope has here removed a considerable portion of the lateral crests.

Another good illustration of Prof. Cope's method of reply is seen in his reference (p. 292) to the date of my communication before the American Philosophical Society. The facts are as follows: In a paper on the *Dinocerata*, which purports to have been "published January 16, 1873," Prof. Cope, not merely antedated his own papers, but changed the date of my communication on the subject from December 20th to December 30th, 1872. This error I promptly corrected in the "American Journal of Science" (v, p. 122). When Prof. Cope's paper appeared in the "Proceedings of the Philadelphia Academy" (1873, p. 11) the date was rectified, and now he refers to the emended paper tri-

umphantly, conveying the impression that my criticism on this point had no foundation! No better evidence of the justice of my strictures could be given than the means Prof. Cope has taken to answer them.

Prof. Cope again refers to the affinities of the *Dinocerata* as though he had settled the question. The value of his opinion on the subject may be readily estimated from the fact that in describing the single skull which he figures in his paper, he mistook canines for incisors; nasals for frontals: maxillaries for premaxillaries; maxillaries for nasals; and maxillaries for frontals! His remarks on the Classification of Mammals, likewise, will afford as much amusement to those familiar with the subject, as did his recent attempt to make Cuvier share one of his own most stupid blunders.*

Prof. Cope's defence of his claimed discovery of cretaceous coal in Wyoming lacks both candor and accuracy. Cretaceous coal was well known in this region before Prof. Cope ever saw Wyoming. In his paper on the subject he ignores this fact, and also my discovery of Dinosaurian remains with coal in the same basin, two years before (Am. Jour. of Sci., Vol. i, p. 195). When corrected on this point he boldly asserts that my locality was from one hundred and fifty to two hundred miles distant, when in fact it is less than seventy miles! And yet Prof. Cope charges his critic with being ignorant of the geography of this region!

II.

Having shown that Prof. Cope's attempts to explain away a single one of his blunders about the *Dinocerata* have resulted in failure, it remains to consider next the date of his late papers on Wyoming fossils. I have asserted (p. 151) 1st. That the dates assigned to the advance copies of these papers are not those of actual publication; 2nd. That as finally published in the "Proceedings of the American Philosophical Society," seven of these papers are antedated. Both of these statements are strictly true. It will be observed that the two charges are quite distinct, and do not necessarily have any connection with each other. The former relates to the distribution of advance copies of the papers in question; the latter to the dates in the "Proceedings of the Philosophical Society." Prof. Cope has greatly confused the question

* Proc. Phila. Acad., 1873, p. 12.

by putting the two together, but truth can best be reached by separate consideration of them.

Prof. Cope attempts to gain an important advantage at the start by assuming that mere printing is publication. This he has no right to do, as the usage of the best naturalists is decidedly against it. In the note from which he quotes, I assumed that publication of scientific results means *making them known*, especially to those interested, and in the case of advance copies, these must be made accessible to those working in the same department. Judged by this well established standard, not one of Prof. Cope's papers was published at the date claimed. The mere printing of these papers has no more to do with their publication than has the invention of the printing press. Both events preceded this publication, but neither of them constitute it.

Prof. Cope first brings forward a certificate from his printers. With these gentlemen I have no controversy, but only commendation for their well-meant, but vain attempt to aid Prof. Cope in his present extremity. The document they have signed bears internal evidence of having been written by Prof. Cope himself, as it contains two erroneous quotations, several false inferences, and is so ambiguously worded that it is impossible to tell what it really means. These gentlemen kindly but thoughtlessly signed this certificate for Prof. Cope, precisely as they kindly but thoughtlessly printed at the head of his papers, "Read before the American Philosophical Society, etc.," when a single inquiry would have shown that not one of them had been read, or even presented to this Society.

The only point worthy of consideration in this certificate is the statement relating to the time of delivery of the extra copies, and here disinterested testimony becomes important. To ascertain the exact truth about this delivery, Professor Lesley, Secretary of the American Philosophical Society, applied to the same printers, and in a recent letter, which I retain, he gives the result of his inquiries as follows:—

"Stavely & McCalla inform me that in every case Cope's extras were not delayed more than twenty-four hours, and sometimes were sent to King on the very day of the printed date at the foot of the page."

This is a very different statement from the certificate which Prof. Cope induced these accommodating gentlemen to sign, and it proves conclusively that the papers in question were not usually delivered

on the day of printing, and hence could not have been published at the dates claimed. This is an essential point, as a single day decides priority in some of the most important cases, and to gain this day Prof. Cope has mainly directed his serpentine efforts.

The other two certificates which Prof. Cope's friends have signed have little bearing on the present question, as they give no definite information as to the real point at issue. The one signed by Mr. King, however, proves that Prof. Cope himself is responsible for withholding his papers from all naturalists working in the same department, as he prepared the list of addresses. Any weight this certificate might otherwise have had is materially diminished by the fact that the list of papers given does not include some of the most important in the series Prof. Cope claims to have published.

The third certificate, as it now stands, carries no authority. It shows the same parentage as certificate No. 1, and is equally ambiguous; but, being shorter, it contains only one false quotation and less misrepresentation. It refers to the "above papers," but gives no indication of what papers Prof. Cope mentioned in distributing this circular, and has nothing to show that the list was the same in each instance. If this really was the case, it is a marked exception to the other points in Prof. Cope's explanation.

The quotation in this circular affords a good example of Prof. Cope's jugglery with words, when he finds the facts against him. He has not merely misquoted, but he has entirely changed the meaning of the sentence by applying it to his extra papers, and not to the dates in the "Proceedings," as it stood in my note.

Taking these three certificates together, there is nothing in them that proves any single one of the doubtful papers to have been published as claimed. The note on *Loxolophodon*, e. g., to which Prof. Cope now gives the date of Aug. 19, 1872, did not have this date on it when printed, and some of the other papers had no dates whatever. One lot, at least, remained at the rooms of the Philosophical Society over a month, after printing, before any of them were distributed. To claim publication under such circumstances is an outrage, which should be resented by every naturalist.

The only evidence of any weight about distribution is where the date of receipt of each individual paper is noted at the time. Such record was kept by the editors of the NATURALIST;* by the editors

* See Book Notices in Vol. vi, where my papers are duly recorded.

of the "American Journal of Science;" by Prof. Baird of the Smithsonian Institute; by the Academy of Natural Sciences in Philadelphia, and at most of the other scientific centres in this country. Had Prof. Cope sent a single copy of any of his papers to these places, it would have gone on record. The fact that he withheld all his papers from these points for months after his claimed dates speaks for itself. These dates have recently been rejected by the American Philosophical Society, where the papers were finally published, and there is now little doubt that they will meet the same fate at the hands of other scientific authorities.

III.

Prof. Cope wisely refrains from offering any explanation of the antedating of seven of his papers in the "Proceedings of the American Philosophical Society," Vol. xii. As the facts in this case are beyond question, I leave Prof. Cope to settle this point with the Society itself, which now has the matter in charge, as well as several other of this author's similar "errors," as I have charitably called them. It is important to bear in mind, in this connection, that these wrong dates, as well as the many others I have pointed out in Prof. Cope's work, are *all in his favor*, so that, assuming them to be errors, the law of chances has evidently made an exception for his especial benefit. An unfortunate dilemma likewise here presents itself, viz:—If these numerous mistakes and erroneous dates which abound in Prof. Cope's papers are merely blunders, his work is worthless from its unreliability; if they are not unintentional, Prof. Cope must assume the full responsibility of them.

IV.

In regard to his Report in "Nature," of the meetings of the American Philosophical Society, it is sufficient to say that Prof. Cope's attempted explanation (p. 296) does not meet the case at all. This report was entirely false, as I have shown (p. 307). When Prof. Cope was called upon before the above Society to explain this, he stated that the dates were taken from the table of contents of the Proceedings, an explanation at once disproved by a reference to the table itself. His present explanation is totally different, and is in itself absurd, as a comparison of the note referred to with the report at once shows. Prof. Cope here, and in a recent number of "Nature" (Vol. viii, p. 34), characteris-

tically leaves the impression that he is not the author of the report; when both his own admission before the Philosophical Society, and the internal evidence in the report, have placed this authorship beyond a reasonable doubt. "*Mens conscia recti*" indeed!

Professor Cope's "table of nomenclature" is only surpassed in ingenuity of construction by his certificate No. 3; and for direct misstatements is without a parallel in his whole explanation. Everything in the column devoted to his own work is wrong. The *Lefalophodon* note, on which he now claims the date of Aug. 19th, was merely an unintelligible telegram of no scientific value whatever, and it was not printed until after that date, and not distributed before November, when Prof. Cope returned from the West, and learned at the rooms of the American Philosophical Society that it had not been published. *Tinoceras*, although not published until Aug. 19th, was printed several days earlier. The statement that no species of this genus was described Aug. 19, 1872, is wholly untrue, since *Tinoceras anceps* dates back more than a year ("American Journal of Science," ii, p. 35), as the Professor knows perfectly well. A reference to the literature of the *Dinocerata* will correct several other gross mistakes in this table.

The only satisfactory evidence Prof. Cope has adduced in favor of the publication of any of his papers before Oct. 29, 1872, is a single newspaper item (p. 297) of no scientific authority. Even here his ruling passion shows itself, as he has antedated this item a whole year!

The question of priority, therefore, stands as follows: —

1st. If mere printing is to be regarded as publication, my papers relating to *Tinoceras*, as well as the others, were published before any of the dates claimed by Prof. Cope.

2d. If distribution of separate copies among naturalists interested in the subject decides the question, my papers antedate his in every case by more than a month.

3d. If appearance in a scientific journal is essential to publication, all my articles were published more than three months before any of his.

Prof. Cope's concluding remarks about fossil birds and reptiles were entirely uncalled for, as they have nothing to do with the present discussion. His reference to *Meleagris altus* Marsh was

especially unfortunate, as in this case he had endeavored to secure priority by sharp practice, and failed (Amer. Jour. of Sci., iv, p. 260). For this kind of sharp practice in science, Prof. Cope is almost as well known as he is for the number and magnitude of his blunders. His next statement about his services in describing certain fossil reptiles is not true. The value of his aid in this department of palæontology may be judged from the fact that after a long study of this group he did not even know the position of the quadrate bone;* mistook the ilium for the ischium;† and after investigating a very perfect specimen for months, he placed the *head on the end of the tail*, and restored the animal in this position as the type of a new order, *Streptosauria!*‡

The present controversy was forced upon me by Prof. Cope's misstatements and mistakes, which I had borne for years in silence, if not with equanimity. My part of the discussion ends, I trust, with this article. Prof. Cope's errors, if not his misstatements, will, I fear, continue to invite correction, but these, like his blunders, are hydra-headed, and life is really too short to spend valuable time in such an ungracious task, especially as in the present case Prof. Cope has not even returned thanks for the correction of nearly half a hundred errors.

To sum up, briefly, the results of this discussion, it is now plainly evident that:—

1st. Prof. Cope committed a series of blunders in his papers on the *Dinocerata*, which are without a parallel in the annals of science.

2d. He has failed to make it even probable that a single one of his doubtful papers was *published* at the date claimed.

3d. He deliberately withheld his papers from every naturalist to whom they would be of immediate service.

4th. In refusing to explain the antedating of seven of his papers in the "Proceedings of the American Philosophical Society," he virtually assumes the responsibility of it.

5th. His report in "Nature" of the meetings of this society was false, and his two attempts at explanation carry with them their own refutation.

Yale College, May 26, 1873.

* American Journal of Science, iii, p. 448. † Same Vol., p. 452.

‡ Proceedings Boston Society of Natural History, 1869, p. 265 and Transactions American Philosophical Society, Vol. xiv, p. 40, 1st ed.